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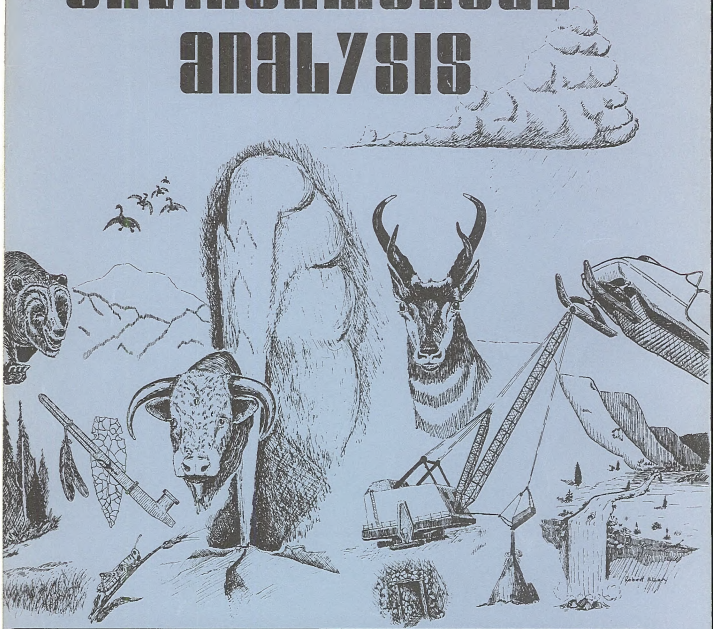

final
environmental analysis record
TIMBER MANAGEMENT PLAN
MISSOULA SUSTAINED YIELD UNIT

missoula district montana

UNITED STATES DEPARTMENT OF THE INTERIOR
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1791 ENVIRONMENTAL ANALYSIS

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MISSOULA SUSTAINED YIELD UNIT
TIMBER MANAGEMENT PLAN

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INTRODUCTION

Evolving from an era of common use of public timber, many restraints have been placed upon the harvesting of timber from National Resource Lands (NRL). In addition to the legal authority for disposing of timber set forth in the Materials Sales Act of 1947 (amended 1955 and 1962), there has been legislation which either directly or indirectly affected the practice of harvesting public timber. There is, to name a few, the Classification and Multiple-Use Act of 1964, the National Historic Preservation Act of 1966, the National Environmental Policy Act of 1969, and the Federal Water Pollution Control Act PL 92-500, 1972.

Timber harvesting from these NRL's is further controlled by the Bureau's own planning system through the Unit Resource Analysis, Management Framework Planning, and the Allowable Cut Planning System.

Out of a composite of all the above mentioned forces emerge those lands environmentally and economically suitable for the continuous production of timber and an allowable cut for these lands.

The National Environmental Policy Act of 1969 directs all agencies to prepare a detailed environmental statement on all actions significantly affecting the quality of the human environment.

The total timber management program of the BLM was judged to have significant environmental impact. A draft Environmental Impact Statement was released in January 1975 for public review. Prior to the issuance of a final EIS, the Bureau became involved in a suit with the Natural Resources Defense Council concerning the Bureau's Timber Management Program. An agreement was reached with the NRDC which specified that (1) EIS's are to be written on the timber management plans for all sustained yield units in western Oregon, and (2) decisions for the need of EIS's on the timber management plans for sustained yield units outside of western Oregon will be made on the merits of each case.

The purpose of this EAR, then, is to determine if the Timber Management Plan for the Missoula Sustained Yield Unit (SYU) is a major federal action causing significant environmental impacts or having a high intensity of public interest, thereby requiring an Environmental Impact Statement. If an EIS is not necessary, the action will proceed based on the Environmental Analysis Record.

The Missoula Sustained Yield Unit includes all the National Resource Lands in Missoula, Granite, Powell, and Lewis and Clark Counties. The Timber Management Plan includes the allowable cut planning system and timber activity plans that deal with the implementation of the allowable cut.

This programmatic analysis of the Timber Management Plan (including the allowable cut), includes the application of silvicultural practices that would be used to implement the program, and the effects that can be expected from this program on the environment in and around the Missoula SYU.

A programmatic type of analysis is not meant to preclude detailed analysis of silvicultural actions on a site specific basis. A site specific plan (called a compartment development plan) will be prepared prior to a timber sale in an area. An environmental analysis will be prepared for each compartment development plan. It may be that, because of unique impacts or an unusual degree of public interest, a formal environmental impact statement will have to be prepared for a specific timber sale or compartment development plan.

SUMMARY

There is a total of 216,000 acres of National Resource Lands in the Missoula Sustained Yield Unit (SYU). Approximately 144,000 acres (67%) are classified as commercial forest land. The BLM proposes to implement a 10-year multiple-use oriented, timber management program on 100,000 acres of commercial forest land within the SYU. Implementation of the proposed action over the 10-year period will have a direct effect on approximately 25 percent (25,000 acres) of the commercial forest land.

The objective of the timber management plan is to produce a high level of wood products subject to the principles of multiple use, sustained yield, and environmental quality and protection. Forty-four thousand acres were classified as development deferred areas and removed from the commercial forest land base until a multiple-resource inventory is completed and Bureau land use plans revised. Approximately 10,000 acres are restricted to modified cutting in order to protect other resource values, such as recreation areas, streamside corridors, watershed protection, scenic corridors, and wildlife habitat.

The practices are diverse, but those of major importance relate directly to harvest of mature trees (logging, road construction, and slash disposal). Over 90% of the final harvesting will be by shelterwood cutting, which requires harvesting in three stages, with at least a 10-year period between each stage. This method allows essentially continuous canopy management in that the next stand of trees is regenerated prior to complete removal of the overstory. Some immature trees will be destroyed in harvesting operations. Pre-commercial thinnings prescribe cutting of immature trees to concentrate growth on fewer trees to produce quality forest products. Control measures for insects, disease, and wildlife are also discussed and evaluated.

The potential for adverse impacts is tremendous. Drawing on a wealth of research results, practical experience, and the direction provided by multiple-use oriented land use plans, a timber management plan has been proposed which reduces the impacts to what we consider an acceptable level. The plan has the flexibility to be responsive to changing conditions, new knowledge, and changing public attitudes.

Beneficial impacts are both environmental and economic. More of the forest's natural productivity will be realized, and the products removed will meet public needs and help provide a living to residents of western Montana. This proposal involves a small portion of the commerical forest land in the counties involved and in western Montana. This should be kept in mind when evaluating both the significance of environmental and economic impacts. The 7 million cut proposed is one-half of one percent of the annual cut for western Montana.

Residual impacts will include some impact on air, land, water, wildlife, and human values. Of the physical factors, impacts on land are the greatest. Most of the impacts in terms of soil erosion and loss of productivity relate to road building. Impacts on the aesthetics of areas under management are among the most important of the human values. Changing land uses on adjacent lands will impact and be impacted by the proposed action. It is difficult to predict future private land uses, but the trend of land use changes (towards homes, cabins, recreation, etc.) and the growth of these uses tends to increase impacts of and on timber management. Effects on long term productivity and commitment of resources are minor, limited mostly to roads. Such loss of productivity will be exceeded many times over by the maximizing of productivity potential through intensive forest management practices consistent with environmental protection. Changes in vegetation and the presence of man will affect animals, in terms of habitat, population, and behavior.

Public interest in program level determinations of forest practices has been evidenced during meetings held on land use planning. The public has generally accepted the practices and planning approaches proposed in this action. People have a tendency to become much more interested in individual timber sales or small areas within the SYU where they make use of NRL and are more familiar with the environment. Thus, the intensity of interest in individual actions taken under this proposal will probably generate more interest than the overall action. The proposed action has not generated a great deal of interest from the public and special interest groups.

The analysis points up the importance of preparing compartment development plans within the SYU in conjunction with individual timber sales. Each of the proposed actions will be accomplished by environmental analysis which will supplement this analysis. Public involvement in these proposals is essential.

CHAPTER 1

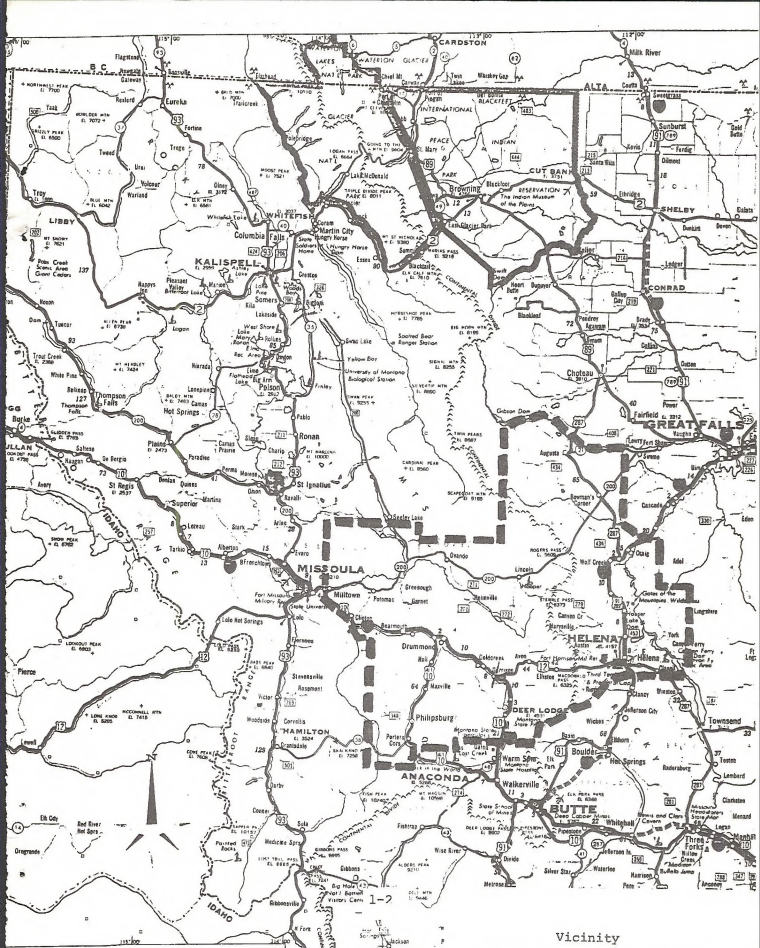
PROPOSED ACTION

The forests around Missoula and throughout Western Montana have played a major role in the area's development and economic conditions. The forest products industry for many years has been one of the key economic factors in the area. Forest based recreation has been and is becoming more popular in the area. Recreation has also become an increasingly important source of cash flow. The traditional use of BLM administered lands in the Missoula District has been directed at forest management.

The Missoula Sustained Yield Unit produced approximately 10 million board feet of forest products annually during the 1960's. Since that time, the annual rate of production has been approximately 3.5 million board feet. The reduction in harvest has been primarily due to funding and manpower levels established by the U.S. Congress.

Currently, there exists a national demand for wood products which has caused a shift to more intense management of the forest land base, and improved wood utilization.

The National Resource Lands (NRL) discussed in this EAR are all located in Western Montana in Missoula, Powell, Granite, and Lewis and Clark Counties. For the most part, these lands are located in the Garnet Mountain Range (see maps 1 and 2). The 216,000 acres of National Resource Land in the Missoula SYU includes 144,000 acres of commercial forest land. Through our planning system, forest land available for timber production under normal cutting practices was reduced to 100,000 acres (see Appendix 2). These lands produced over 94 percent of the BLM's total timber production within Montana in the last three years. Subject to the principles of multiple use, sustained yield, and environmental quality, the primary objective of the timber management program in the Missoula SYU is to produce the maximum amount of raw material from these commercial forest lands classified as available for timber production.


CARDSTON
Milk River
ALTA
Lethbridge
Sunburst
Dunkirk
Oilmont
Ferdig
Galata
Baker
WATERTON GLACIER INTERNATIONAL PEACE PARK
Chief Mt.
Waterton Lakes
Twin Lakes
Whiskey Gap
INTERNATIONAL BOUNDARY
Blackfeet
Indian
Reservation
CUT BANK
Browning
Blackfoot
Reservation
The Indian Museum of the Plains
SHELBY
Conrad
Ledger
Valier
Sunburst
Kevin
Sunburst
Oilmont
Ferdig
Dunkirk
Devon
Eskers
Galata
Baker
Joplin
Inverness
Big Sandy
Box Elder
Rudyard
Havre
Hingham
Gilford
Rocky Boy Agency
Beaver Creek
Kremlin
Gildford
Hogeland
Chinook
Harlem
Zurich
Dodson
Turner
Malta
Saco
Whitlash
Hinsdale
Glasgow
Nashua
Opheim
Scobey
Flaxville
Peerless
Plentywood
Westby
Medicine Lake
Antelope
Redstone
Culbertson
Fairview
Sidney
Lambert
Richey
Terry
Fallon
Baker
Ismay
Broadus
Powder River
Carter
Ekalaka
Alzada
Camp Crook
Harrison
Buffalo Jump
Arvon
Custer
Miles City
Forsyth
Rosebud
Colstrip
Hysham
Melstone
Roundup
Musselshell
Harlowton
Ryegate
Lavina
Shawmut
Judith Gap
Moore
Winnett
Grass Range
Mosby
Jordan
Fort Peck
Glasgow
Wolf Point
Poplar
Brockton
Froid
Culbertson
Scobey
Plentywood
Whitetail
Columbia Falls
Martin City
Hungry Horse
Essex
Java
Bigfork
Somers
Lakeside
Kalispell
Whitefish
Libby
Troy
Eureka
Rexford
Fortine
Trego
Yaak
Yaak River
Tobacco Valley
Creston
Lake Mcdonald
Glacier Park
Apgar
Polebridge
Columbia Falls
Whitefish
Kalispell
Libby
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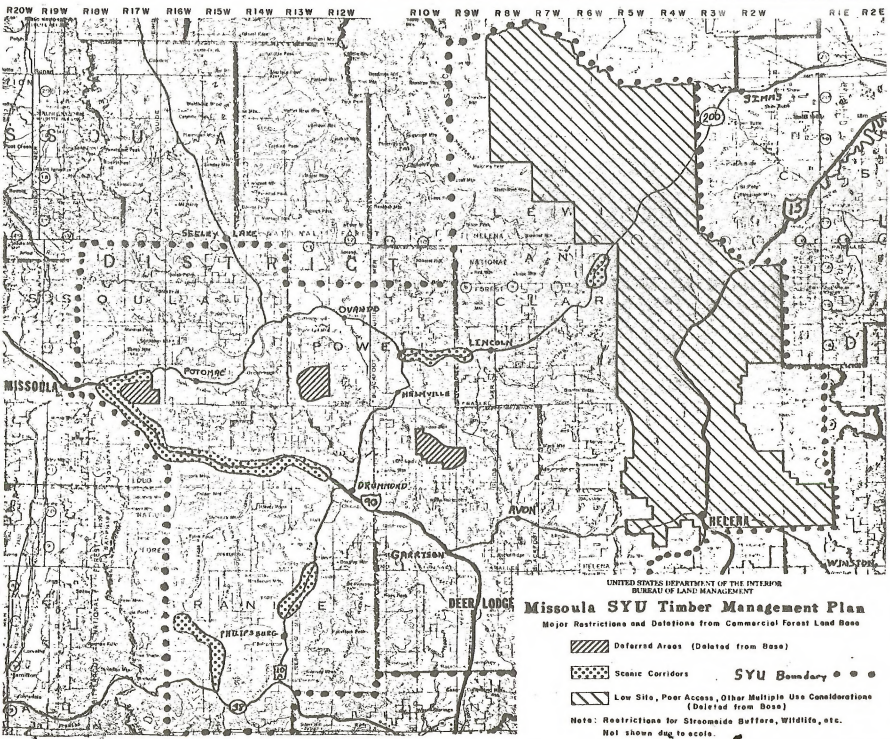
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T21N T20N T19N T18N T17N T16N T15N T14N T13N T12N T11N T10N T9N T8N T7N T6N T5N
SEELEY LAKE
MISSOULA
OVANDO
LINCOLN
POTOMAC
HELMVILLE
DRUMMOND
GARRISON
PHILIPSBURG
DEER LODGE
AVON
HELENA
WINSTON
SIMMS
200
15
90
10
93
1-3
UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
Missoula SYU Timber Management Plan
Major Restrictions and Deletions from Commercial Forest Land Base
Deferred Areas (Deleted from Base)
Scenic Corridors
SYU Boundary
Low Site, Poor Access, Other Multiple Use Considerations (Deleted from Base)
Note: Restrictions for Streamside Buffers, Wildlife, etc. Not shown due to scale.

The total 1975 harvest for western Montana was 800 million board feet. Of the total, a majority comes from Forest Service lands (370 million) and private lands (400 million feet). BLM harvest from the SYU is one-half of one percent of the total.

The District has consulted with the Montana State Office and Washington Office of the BLM concerning policy and alternative selection. The guidelines contained in the forestry program activity policy statement (BLM Manual 1603) and other directives indicate that BLM lands in Montana are to be managed for maximum yield, commensurate with multiple use and environmental considerations, using intensive forest management practices. Therefore, the proposal is a timber management program commensurate with multiple use and environmental considerations using intensive forest management practices (see timber management plan Appendix II). The level of yield is governed by the ability of the forest to respond to various cultural and management practices aimed at increasing natural forest productive capacity. Sustainable harvest level under this alternative is 70 MMBF/decade. To produce this volume, approximately 24,450 acres would be cut every 10 years, of which 23,350 would be selectively cut and 1,150 clearcut (based on a computerized forest management model).

The timber management program would be implemented in five generalized stages. These states are (1) inventories and planning, (2) harvest, (3) slash disposal, (4) development, and (5) protection.

Two types of forest inventories are used. The extensive inventory uses a double-sampling procedure to estimate forest land area and a 10-point subplot cluster to obtain the field data that is used in the allowable cut calculation.

Intensive inventories are done on a compartment basis and they recommend forest management practices for those areas within the compartment suitable for intensive forest management. These areas are analyzed according to criteria such as in-place stand condition, age, volume, growth rates, site classes, and habitat types.

In the first step of our land use planning process, portions of the planning unit land base that are suitable for commercial forest production are identified. The second step lists the activity recommendations for full timber production. In the final step, the activity recommendations are tempered by policy, environmental considerations, and multiple use trade-offs. (See Timber Management Plan for the Missoula Sustained Yield Unit, Appendix II of this EAR). This results in a generalized zoning of the planning unit which identifies portions of the commercial forest land base which are available for intensive timber production, portions of the commercial land base on which management practices must be tempered because of environmental or multiple use considerations, and portions of the commercial forest land base which are not available for timber production because of the same considerations.

In the Timber Management Plan, technical data from the extensive forest inventory is used to determine the level of harvest that will provide the maximum sustained yield of forest products consistent with the multiple use guidelines contained in our land use plans. The allowable cut computation includes those intensive management practices

needed to sustain the levels of harvest during the next decade. It is stated Bureau policy that intensive practices, no matter how technically or economically feasible they may be, are not to be included in the allowable cut calculations unless they meet adequate environmental standards. For example, forest fertilization is not included as an intensive mangement practice. This plan has been written for the Missoula SYU (see Appendix II.)

The timber sale plan involves carrying out the timber management plan on a yearly basis. Stated simply, the plan identifies those tracts included in the timber production land base which, based on silvicultural considerations, have a priority for harvest. The implementation of the timber sale plan is described as follows:

> Plan formulation is on a fiscal year basis. The proposed sale plan is exposed for public comment both by dissemination to interested parties and various segments of the public, for any possible coordination needed with planned activities of other agencies or landowners.

The planning units are further divided into compartments. These compartments are the basic land unit upon which we do silvicultural planning. We call this Compartment Development Planning, and these plans are simply site-specific timber management plans. The priority for accomplishing these plans comes from the selection of an area within a compartment for harvest. Selection is based on recommendations made by the area forester in charge of planning.

An environmental analysis is made for each Compartment Development Plan, and a decision made to harvest stands or continue the analysis in the format of an EIS. If an EIS is prepared, it will guide a decision on which stands to harvest. The stands or stand in the compartment with the highest priority for harvest are then marked for sale. The design of these particular tracts, including such things as size, road locations,

logging systems, whether or not buffer strips are left, etc., is guided by land use plans and the environmental analysis. Sale layout is a crucial step in seeing that the intent of the planning is carried out in the individual on-the-ground application of management decisions.

At this point in the process, the individual timber sale is advertised and sold. This begins the cycle of harvest, regeneration of a new stand, cultural measures applied to the new stand, and protection of the new stand until such time as the stand again undergoes a harvest cut. The management practices used in this cycle and their respective environmental impacts are described in the remainder of this document.

The selection system involves the removal of mature and immature trees, either singly or in groups, at intervals. Regeneration is established almost continuously. The objective is maintenance of an uneven-aged stand, with trees of different ages or sizes intermingled singly or in groups. This system is aesthetically pleasing, but is difficult to apply successfully unless the stand structure is favorable. The two types of selection are individual tree selection and group selection.

Individual (single) tree selection involves the removal of individual trees rather than groups of trees. In mixed stands, it leads to an increase in the proportion of shade-tolerant species in the forest.

Group selection can be used to maintain a higher proporation of the less shade-tolerant species in a mixture than individual tree selection. For this purpose, larger harvest groups are more effective than smaller ones. In some stands, groups a fraction of an acre in size are generally suitable. In others, the groups may be as large as an acre or two. When groups are of maximum size, they resemble small clearcut patches. The group selection system is distinguished from clearcutting in that the intent of group selection is ultimately to create a balance of age or size classes in a mosaic of small contiguous groups throughout the forest.

In the shelterwood system, the mature stand is removed in a series of cuts. Regeneration of the new stand occurs under the cover of a partial forest canopy between cuts. A final harvest cut removes the shelterwood and permits the new stand to develop in the open as an even-aged stand.

This system provides a continuing cover of either large or small trees. It is especially adapted to species or sites where shelter is needed for the new reproduction, or where the shelterwood gives the desired regeneration an advantage over undesired competing vegetation (see Figures 1, 2, and 3).

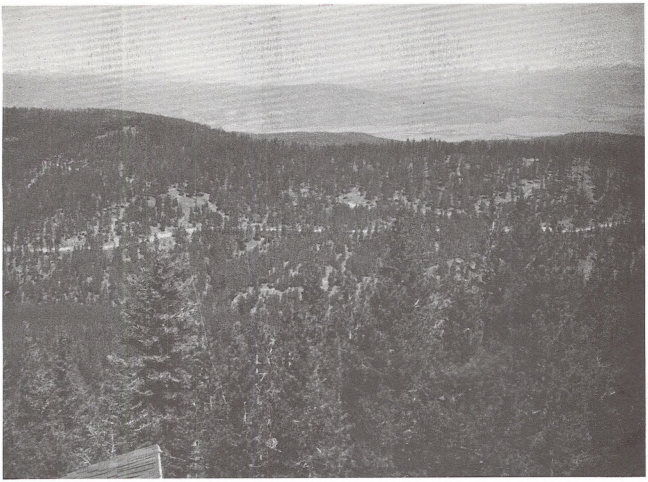


Figure No. 1

General view of cutting unit following the second cut of a shelterwood system. In this unit, the volume removed averaged 11 MBF/acre, volume remaining was 4 MBF/acre.

Figure No. 2

Stand of mature Douglas-fir
Average volume/acre - 17 MBF (thousand board feet)

Figure No. 3

Same stand shown in Photo 2 following the second cut of a shelterwood system. Volume removed was 13 MBF/acre, volume remaining was 4 MBF/acre.

The seed-tree system involves harvesting nearly all the timber on a selected area in one cut. A few of the better trees of the desired species are left well distributed over the area to reseed naturally. When feasible, the seed trees are harvested after regeneration is established. (See Figure # 4.)

Clearcutting is the harvesting in one cut of all trees on an area for the purpose of creating a new, evenaged stand. The area harvested may be a patch, stand, or strip large enough to be mapped or recorded as a separate age class in compartment development planning. Cleared areas over two acres are considered clearcuts. Regeneration is obtained through natural seeding, planting, or direct seeding. This system requires careful location of boundaries to fit the landscape and appropriate cleanup of debris to improve the appearance of the harvested area. The absence of reserved trees on the clearcut area facilitates site preparation and other area-wide cultural treatments.

The movement of felled timber from the stump to the loading point (landing) is accomplished through the use of a yarding system or combination of yarding systems best suited for the area to be harvested.

The various yarding systems used or having potential for use in this sustained yield unit are horses, tractors, jammers, self-loading trucks, mobile yarder-loaders, high lead, standing skylines, and running skylines.

Horse skidding is still used advantageously in some situations. On suitable terrain they are well adapted to skidding small logs such as those produced in commercial thinnings. Horses can be used on narrow skid trails with minimum damage to the residual stand. They are best suited to skidding small logs down slope on gradients under 40 percent, for maximum distances not exceeding 600 feet.

Figure No. 4

Seed tree cut
Slash has been machine piled and burned

Either caterpillar type tractors or rubber tired skidders may be used in tractor skidding operations. Both types of tractor are used most effectively for downhill skidding on slopes under 40 percent, and for maximum distances less than 1500 feet. Uphill skidding for short distances is feasible on gentle slopes, particularly for the larger crawler tractors. Often tractors complement other systems. A combination sometimes used on sidehill settings is downhill tractor skidding of the upper part and uphill high-lead yarding of the lower part to the same roadside landing.

The jammer (usually a homemade machine) employs a boom and an engine-powered drum, on which is wound a wire-rope cable used for both yarding and loading. While basically a machine for loading trucks, the jammer may be used for yarding logs for relatively short distances (usually not exceeding 300 feet). On slopes too steep for tractor operation, the jammer's limited yarding capability can be useful with a system of roads on contours spaced at slope distances of 400 feet or less.

The self-loading truck is commonly equipped with a short horizontal boom with fairlead, and cable wound on a drum powered by take-off from the truck engine. Under favorable conditions, such trucks can yard logs from locations within 100 feet of roadside.

Mobile Yarder-Loaders are employed in situations where neither high-lead nor tractor logging is practical. The mobile yarder-loader is particularly adapted to removing small total volumes of timber, to operating in stands of low volume per acre, or in small timber on steep terrain.

While there are several variations of mobile yarder-loaders, they have certain common characteristics:

- All are self-propelled, and can be driven from setting to setting (as opposed to most high-lead yarders).
- All are equipped with booms or spars which, when erected,

The running skylines are the most recently developed of the skyline systems. They are becoming widely used in the northwestern United States, and are replacing standing skylines and high-lead systems in some applications. A past disadvantage of these systems has been a rather short span capability (reach) of about 1000 feet. However, yarders with reaches exceeding 2000 feet are now available. The running skyline is particularly well-suited to yarding intermediate cuttings and harvest cuttings of a partial nature, where damage to trees left standing must be minimized. Properly equipped and utilized, running skylines may yard clearcuttings as effectively as the high-lead. Due to high costs, general use of these systems in western Montana is unlikely in the next decade.

It is not anticipated that either balloon logging or helicopter logging will be utilized within the Missoula SYU, at least, within the next decade or two. The reason is that our volume per acre is not high enough to support these high cost systems.

Table 1 charts the relative characteristics from a high of A to a low of E of the yarding systems versus the desired characteristics in terms of physical environmental silvicultural and economic criteria.

Of course, any such system of qualitative ratings is subjective and must be adjusted to reflect more specific equipment or yarding constraints.

Transportation in the context of timber management is required to move logs from the landing or loading site located in the cutting area to a market destination which may be a few miles to 100 miles distant.

The principal transportation medium is the logging truck. Because of intermingled land ownership patterns, the development of road systems often requires cooperation with adjacent landowners to insure access to the local, state and Federal highways that lead to the manufacturing centers.

Table 1 --- RELATIVE CHARACTERISTICS OF VARIOUS YARDING SYSTEMS

DESIRED CHARACTERISTICS	YARDING SYSTEM								
				STANDING SKYLINE		RUNNING SKYLINE			
PHYSICAL CRITERIA	JAMMER	TRACTOR OR SKIDDER	HIGH LEAD	SINGLE SPAN	MULTI-SPAN	GRAPPLE YARDING	CHOKER LOGGING	BALLOON LOGGING	HELI-COPTER LOGGING
Compatibility with Road & Bridge Restrictions									
Compatibility with Health & Safety Codes									
Compatibility with Timber Size									
Min. Sensitivity to Ground Profile	B	C	B	C	C	C	C	B	A
Min. Sensitivity to Soil Conditions	C	E	C	B	B	B	B	A	A
Min. Sensitivity to Atmospheric Conditions	B	B	B	B	B	B	B	E	E
Min. Dependence on Tie-Downs	C	A	D	D	D	C	C	D	A
ENVIRONMENTAL & SILVICULTURAL CRITERIA									
Min. Access Road Density									
Capability to Yard Extended Distances	E	C	C	B/C	B	B/C	B/C	A	A
Suitability for Uphill Logging	A	D	A	A	E	A	A	D	B
Suitability for Downhill Logging	E	B/E	D	C/E	B	C	C	A	B
Min. Landing & Service Areas	A	C	C	C	C	A	A	D	D
Min. Soil & Water Disturbance & Soil Compact'n	C	E	C	B	B	B	B	A	A
Suitability for Partial Cuts	E	A	E	A/E	A	E	A	D	B
Suitability for Clear Cuts	A	A	A	A	A	A	A	A	A
Min. Impact on Fish, Wildlife & Range Habitat									
Suitability for Irregular Shaped Settings	D	B	C	B	C	B	B	B	A
Suitability for Clean Yarding	C	A	C	B/C	B	B	B	B	E
Min. Unit Fuel Consumption	B	C	C	B	B	B	B	C	E
ECONOMIC CRITERIA									
Min. Yarding Cost									
Min. Hourly Cost	A	A	C	B/C	B/C	B	C	D	E
Max. Hourly Production	C	C	B	B	D	B	B	C	A
Min. Sensitivity to Stand Density or Yield									
Min. Move-In Cost	A	A	C	C	C	B	B	D	B
Min. Set-Up Cost	B	A	C	C	E	B	B	C	A
Max. Annual Utilization	B	C	B	B	B	A	B	D	D
Max. Economic Life									
Max. Return on Equipment Investment									
Max. Return on Stumpage									

While the Bureau roads serve other forest values and uses, the cost of construction and maintenance is usually carried by the timber resource and is provided for under the terms of the timber sale contract. In limited cases, appropriated lands may be used to construct some of these roads.

Road design varies with the amount and type of use, topography, and other variables. However, roads generally range from 10 to 14 feet in usable width. Road clearing width varies from 25 to 50 feet. Not all roads are part of the permanent road network. Some are used and then abandoned or temporarily blocked. Permanent road systems may also be blocked during certain periods of the year to protect other resource values.

The transportation system requires road construction in many areas. These roads are constructed to various widths and alignment standards and specifications depending upon the need. Those roads constructed specifically for implementing a Timber Management Plan will usually be held to the width and alignment standards necessary to accomplish management objectives. With the exception of mainline roads, all roads will be blocked until needed again, scarified, and seeded to grass or other vegetation. Cut and fill slopes on all roads will be seeded to grass and forbs as an erosion control measure.

The equipment most widely used in logging road construction is a track (crawler) type tractor with a dozer blade and a ripper. Tractors can also be attached to scrapers for excavation and short hauls; however, trucks or self-propelled scrapers are usually used when earth is to be moved any distance.

Once a mainline road is constructed, it enters the maintenance phase which includes all necessary repairs to keep the road in a safe and serviceable condition.

SLASH DISPOSAL

Slash is the wood residue remaining after logging, thinning, road building or clearing operations. It consists of foliage, twigs, branches, bark, tops, stumps, and unutilized or cull logs and trees. On the average, only 50 percent of the gross weight of a tree is harvested. The rest is left on an area as slash. In days, timber harvest activities can create residues which would require decades to accumulate under natural conditions. Slash is treated to mitigate the impacts of overloading the forest ecosystem with a surplus of organic material.

Clearly, there is a potential demand for entire trees, including twigs and needles. In the future, when we talk about slash and other wood waste residues, the major objectives could well be fuller utilization, instead of the present emphasis on how to destroy them in an environmentally sound manner.

Most slash residue requires some form of treatment to meet forest protection and management objectives. Under natural conditions, fire provides this treatment by preventing excessive fuel buildup. Man's slash disposal treatments should complement natural forest ecosystem without undue impact on either on- or off-site environmental quality.

Principal reasons for slash treatment are to:

(1) Reduce fire hazards, (2) expose mineral soil for seedbed preparation, (3) remove planting, natural regeneration, cultural treatment, and growth obstacles, (4) prevent insect buildup, (5) reduce aesthetic impacts associated with slash accumulations, (6) reduce obstacles to movement of domestic animals, big game and other wildlife (including fish), (7) recycle nutrients.

In most timber sales, a variety of slash treatment options are used. They include burning, mechanical treatment, lop and scatter, and no treatment.

Burning includes broadcast and spot burning, and the burning of hand or dozer piles.

Mechanical treatments include burying, trampling, chipping, chopping, crushing, rolling and high intensity burning. These mechanical treatments, with the exception of high intensity burning, rearrange slash residues. Volumes remain on site. Even though high intensity burning is not a mechanical treatment in the sense of these other described treatments, it fits this category better than the burning category. Slash volumes and terrain have limited use of mechanical methods to less than 5 percent of the total acres treated in the SYU.

The lopping and scattering of slash is a feasible treatment in stands harvested by partial cuts (selective and shelterwood). Deterioriation is hastened by reducing slash to the ground where micro-climatic conditions favor more rapid decay.

It is not usually acceptable to leave slash untreated, as it usually does not meet land management objectives. Undesirable aesthetics, potential insect buildup, stand regeneration problems and obstacles to wildlife and livestock movement remain. Perhaps the greatest threat is that of a fire starting in or near untreated slash and subsequently gaining uncontrollable momentum. It is feasible when cutting produces a low level of slash.

DEVELOPMENT

Practices included in the development phase of the timber management program are primarily aimed at re-establishing trees on forest land following harvest or natural catastrophies and promoting satisfactory or optimum growth of these forests. Actions directly associated with timber harvest, such as cutting to provide regeneration through natural seeding, are discussed in Chapter I-2 (Harvest), even though they bear upon the question of re-establishment and growth. The practices discussed below (tree improvement, site preparation, regeneration, and stand improvement cutting) are in the general order in which they might be carried out on the ground, although several may be accomplished simultaneously. Not all of these practices are carried out on a given area. Many represent alternative methods, the choice of which is dependent upon the condition of the area.

Tree improvement programs are developed to optimize specific genetic characteristics such as growth rate or resistance to disease. Major efforts to date in Montana involve the development of superior ponderosa pine. As an ultimate goal, the Inland Empire Tree Improvement Committee hopes to provide genetically improved tree seed or seedlings for reforestation purposes for all commercial tree species common to the area.

Tree improvement programs require development of centrally located "seed orchards" where genetically improved seed can be produced, and "progeny test areas" where improved seedlings can be grown and measured. Development of these areas may require harvest of timber on selected sites followed by cultivation to prepare the site for planting.

Site preparation is required whenever it is necessary to alter site conditions prior to reforestation. The basic principle of site preparation is to reduce competition and/or expose mineral soil.

Site preparation is usually not a separate operation; whatever preparation is needed is accomplished through log skidding operations and slash disposal.

Management prescriptions for species intolerant of shade (larch, lodgepole and ponderosa pine) will require a greater degree of site preparation than for the tolerant species (Douglas-fir, Engelmann spruce and Alpine-fir).

To supplement natural regeneration, seedlings are planted to reforest cutover areas. Tree planting can be done by hand, using tools such as hoes, mattocks, dibbles, power augers or tractor-drawn machines where terrain permits. Within the SYU, we use hand tools almost exclusively. Seedlings used in the reforestation program are classified as "bare-root" or "containerized." Bare-root seedlings are lifted from growing beds in outdoor forest nurseries prior to breaking dormancy (initial spring growth); they are then inspected, sorted and culled, packaged and placed in cold storage until forest planting sites are clear of snow and frost, at which time they are transported to the site for planting. Conversely, containerized seedlings are grown in individual containers in a controlled environment (heat, light, water, fungicides and fertilizers). The seedlings can be planted whenever the ground and weather conditions are optimum as plant dormancy is not a factor. Seedlings are delivered to the site in their containers, and depending on the type, are either removed from the container and planted, or planted as a unit. Presently, we are using the bare-root method, only because containerized trees are not commercially available here. Planting is proposed only to restock approximately 6,000 acres of non-stocked sites. This will probably take about 10 years. All final harvest methods are designed to allow adequate natural regeneration.

In direct seeding, seed may be scattered by helicopter or by ground crews, either broadcasting or spot seeding. Direct seeding operations

are recommended only where the site index is 60 and above. However, since site index in our stands very rarely exceeds 50, the direct seeding method will be rarely used. If and when it is used, seeding rates per acre should approximate the natural seeding rates of a better than average seed year.

In a thinning operation, surplus trees in established stands of young, pre-merchantable or merchantable timber are removed, so as to release the remaining trees from competition for light, moisture or nutrients, and thereby concentrate growth potential of the stand on the remaining trees of better quality. (See Figure #5.) The primary objectives of this practice are to produce merchantable wood volume and financial returns earlier than the unthinned stands would and to produce more harvestable wood fiber. Commercial thinnings recover usable fiber which would normally be lost to mortality. In precommerical thinning, no material cut is utilized.

By far, the most common method for removing surplus trees involves the use of power saws. Chemical silvicides, such as cacochylic acid or MSMA, will not be used in this SYU. Besides the environmental issue, silvicides have lacked popularity due to their tendency to "run" from the intended tree to adjoining trees. This condition is made possible by certain tree species (such as lodgepole pine and western larch) growing on intertwining root systems. The tree species receiving the bulk of our thinning efforts include lodgepole pine, western larch, and to a lesser extent, Douglas-fir. Leave trees are selected on spacing and condition. They almost always are the more dominant of the overstory, and must have good potential for maturing into sound, usable trees. The exception to this may be when thinning is done for the purpose of removing diseased trees in order to control an infection, such as dwarf mistletoe, camandra rust, or western gall rust.

Figure No. 5

Commercial thinning in Missoula SYU
60 year old lodgepole pine stand

PROTECTION

The primary objective of the forest protection activity is to eliminate or minimize losses to the timber resource and other forest resource values resulting from fire, insects and disease, and timber trespass.

The basic approaches taken on the ground to protect the forest resource from fire, or to control its spread, are pre-suppression, suppression and prevention.

Suppression activities include all of the current control practices, like aerial retardants, helitack, heavy equipment, and organized crews. Throughout most of the SYU, any combination of these control practices can normally be used to control wildfire quickly and efficiently; however, there are designated areas in the northeast end of the Garnet Range and parts of northern Lewis and Clark County where minimal site disturbance receives higher priority than fire suppression with heavy equipment. A more thorough discussion of these areas and their limitations can be found in the Blackfoot, Hoodoo, East Slope, and Gates of the Mountains Land Use Plans.

Fire prevention activities include slash disposal, fire roads, public education, and contract inspection. Slash disposal helps in the reduction of surface accumulation of forest fuels left behind after logging.

Skid roads, fire breaks, trails, and main haul roads often help to make areas more accessible to fire crews. Occasionally roads have been built specifically for future fire suppression. Public education consists of informing the public of potentially hazardous areas. By signing these areas and patrolling them during critical periods, the

potential of man-caused fires is reduced. Also, during extreme fire conditions, forest lands may be closed to all woods operations and general public use. Inspection of logging equipment for compliance with State and Federal fire laws under the terms of the timber sale contract also helps to reduce the threat of fires.

The objectives of forest insect control practices include minimizing forest injury by preventing or suppressing epidemic outbreaks of insect populations with available man-devised methods while giving every encouragement to natural control agents.

Control practices can be classified as silvicultural, remedial or biological, the choice of which primarily depends on the species of insect to be controlled, the degree of infestation, and the conditions that characterize the infested area.

Silvicultural control employs the use of silvicultural practices directed towards preventing the occurrence of insect outbreaks as opposed to actions taken following insect infestations. These practices maintain the forest in a healthy condition and regulate its growth so that food conditions are unfavorable for insect buildup. The quantity and quality of insect food are controlled by regulating the composition, density, vigor and age of the stands. Practices include harvesting trees for stands most susceptible to insect attack. Cutting and regeneration practices can be designed to favor the creation of timber stands of mixed species, since they are less susceptible to insect damage than pure stands. These practices are an integral part of the timber management program.

Direct remedial control involves mechanical and physical methods aimed at destroying the adult and larval stage of certain insects. They include the following methods:

1. Sanitation cutting where the infected trees are felled and removed as marketable material or treated by sun-curing. This method destroys insect larvae.

2. The application of insecticides, usually by aerial spraying. This method is usually considered in control of defoliating insects such as spruce budworm, tussock moth, etc. Due to the high cost and environmental considerations, this method is reserved for areas where an insect problem has reached major proportions. This size of problem has not occurred on NRL within the SYU.

3. Direct burning of infested, unmarketable material on the site, after felling and piling.

Another facet of forest protection involves biological control. Many species of parasitic and predaceous insects as well as insect-eating birds and mammals offer promise in preventing buildup of insects to epidemic levels. It is in terms of prevention rather than control of a damage problem where this method offers the most promise. Biological agents often do control epidemics, but a time lag is involved where the control organism may take several years to overtake the damaging insect. The damage caused to the stand during this lag is often unacceptable in economic terms.

Maintenance of biological control agents is often an integral part of good forest management. Maintenance of diverse, natural systems is important. For instance, cavity-nesting birds such as woodpeckers consume great numbers of insects, but if no suitable nest trees are left in harvesting programs, the habitat and population of woodpeckers will decline.

More exotic aspects of biological control include artificial production of control organisms (example: wasps for larch case bearer)

and introduction of foreign control agents to control an introduced pest. Present knowledge does not allow the manager to make consistent, effective use of these methods at this time.

The objectives of forest disease control practices are to eliminate or minimize the occurrence or spread of dwarf mistletoe, comandra rust, western gall rust, and other tree diseases. Disease control measures currently in use in this SYU are limited to silvicultural or physical measures. Chemicals are available, but not widely used. Biological control, like chemical control, has strong appeal to the imagination, but current technology and/or experience offers little hope for field level use during the next 10 years.

Silvicultural control is aimed at the prevention or minimization of future disease outbreaks, as opposed to actions taken following infestations, and include such practices like: (1) species conversion; (2) development of mixed-species stands - particularly when diseases are host specific and (3) maintaining stands in healthy and vigorous conditions by regulating composition, density and age.

The success of physical control is dependent upon the ability to remove the source of infection. However, once the disease has infected a tree, it is virtually impractical to cut it out of the tree. Thus, control prescriptions are directed towards removing infected trees from the stand. For example, mistletoe infected trees can be used as a seed source. However, once the new stand is established, the infected seed source trees must be removed.

The operations of timber trespassers often cause damage to resource values, mainly due to improper cutting, skidding, road building, and slash disposal. Trespass control is directed to correcting damage to resource values.

CHAPTER 2

DESCRIPTION OF THE ENVIRONMENT

The environment, as discussed here, will be that found on, or closely associated with, those tracts of National Resource Lands listed in the various Unit Resource Analyses as suited for intensive forest management.

The following description will be in generalities, assuming that specific detail will be given in the EAR's on compartment development plans. Detailed descriptions of the environment are also found in all land use plans within the SYU.

CLIMATE AND AIR QUALITY

Climatic conditions found throughout the Missoula SYU are materially affected by the Continental Divide which bisects the unit from north to south.

The area west of the Divide is influenced by Pacific air masses which contribute moisture in the form of snow during the winter months, but little or no rainfall during July and August. Winter months are milder west of the Divide - with the average January temperature ranging from 26°F in the Bitterroot and Clark Fork valleys to about 22°F in the surrounding mountains. Average July temperatures range from 60°F to 68°F.

The area east of the Divide is affected during the winter months by cold air masses from Canada. Generally, these air masses are blocked by the Rockies and funneled in a southeasterly direction. Average January temperatures range from 20°F to 24°F. Summer precipitation over this portion is usually derived from air masses originating in the Gulf region.

The average annual precipitation within the SYU varies from 10 to 14 inches in the lower regions to 20 to 30 inches in the higher mountains. However, west of the Divide, only 50 to 60 percent of the precipitation falls during the growing season; while on the east side, 70 percent falls during the growing season. As would be expected, most of the areas better suited for intensive timber management are found in the more mezic areas west of the Continental Divide.

Air quality is high throughout most of the SYU and may be best described as "mountain fresh." Notable exceptions to this are, (1) the air pollution primarily from the pulp mill in the Missoula area and, to a much lesser extent, the mills in smaller communities within the SYU,

(2) severe dry, dusty periods when the particulate matter may become visible in the form of haze, and (3) the fall slash burning season when particulate matter and hydrocarbons may increase on local levels.

GEOLOGY AND SOILS

The forested lands in the Missoula SYU are located in what is typically referred to as mountainous terrain.

The mountain ranges are of two broad types: intrusive, such as the Garnet Range and Scratchgravel Hills; and structural, such as the Front Range. The intrusive mountains were formed by igneous rocks being intruded (forced) into older sedimentary rocks, usually arching them upward at the central part of the intrusion. Subsequent erosion has exposed the central igneous core. These igneous rocks are easily recognized by their "spherodial boulder" outcrop, and by the presence of abundant sand-like detritus or "decomposed granite."

The structural mountains were formed by folding and faulting of sedimentary rocks. The sedimentary rocks in the structural mountains and surrounding the igneous mountains have been eroded so that their outcrop patterns are concentric or paralleled narrow bands. Most conspicuous of these linear outcrops is the Madison Limestone with its white color, and prominent "flat iron-shaped" outcrops. Volcanic flows occur in several mountainous areas. Most important of these are on the northeast slopes of both the Garnet Range and Hoodoo Mountains, and in the Sleeping Giant and Stickney Creek areas.

Geologic factors influenced most by the proposed action are those that relate to erosion and mass movements (slides, slumps, etc.). The igneous intrusive rocks weather to a sand-like soil and subsoil which is highly susceptible to erosion when the existing vegetative cover is removed. This phenomena is readily observed in the Elk Creek drainage. Some of the younger sedimentary rock and extrusive volcanic rocks are weakly consolidated, and contain a high percentage of clay minerals. These rocks weather to soils which are susceptible to surface flows when their shear strength is reduced by abnormally high precipitation.

Oversteepening of some slopes and accompanying faulting, which is common along the Front Range, has created numerous actual and potential mass movement hazards. Some of these hazards may involve public safety. Others have an effect on road maintenance and soil conservation.

Soils in the SYU are typical of forested land soils found in western Montana. Detailed soils descriptions are available from many sources and are described in compartment development plans.

WATER

Water quality within the Missoula District can best be described as good to excellent. Based on a two year district study of eight streams (12 sampling locations), major water quality parameters such as alkalinity, specific conductance, dissolved oxygen, PH, suspended sediment (nonfilterable residue) turbidity, and temperature easily fall within those standards established by the State of Montana, Department of Health and Environmental Science, and the Federal standards proposed by the Environmental Protection Agency.

There are water quality variations within stream as well as from stream to stream which occur daily as well as seasonally. These variations are due in part to climatic conditions, geology, biota within the stream, and man's activity. Seasonal fluctuations may approach or exceed recommended standards for some parameters, such as turbidity, but usually are of short duration. Watersheds and stream channels in the SYU are generally stable and in good condition. Data on groundwater is found in the resource inventory portions of land use plans.

VEGETATION

Aquatic vegetation in most of the cold mountain streams in the area under consideration is mostly Bryophytes, notably Fontinalis sp. and Fissidens sp. These mosses usually cling in great abundance to the submerged rocks through the streams. In addition, many species of algae occur. Probably the most noticeable is the blue-green algae, Nostoc parmeloides, which forms small pads that cling to the substrate. Higher plant forms that also occur are Water Cress (Nasturtium spp.), Duck Weed (Lemna), Pondweed (Potamogeton spp.), Sedges (Carex), Milfoil (Myriophyllum), Coontail (Ceratophyllum), Horse Tail Fern or Snake Grass (Equisetum), Rushes (Juncus), and Cattail (Typha).

Riparian vegetation is largely the rushes and sedges mentioned above and Alder (Alnus), Willow (Salix), Maple (Acer), Elderberry (Sambuccus), and Chokecherry (Prunus).

Some of the unique habitats such as warm springs, wet meadows and bogs support various plant communities indigenous to these microenvironments. Cenquefoil (Potentialla), Water Hemlock (Cicuta), Sundew (Drosera), Stonewart (Chara), and Waterweed (Elodea) are but a few of the semi aquatic plants commonly found in these areas. Numerous algal forms also occur but have not been identified at this time.

The Missoula SYU is a mosaic of forest, shrub and grassland formations, whose presence is determined by macroclimate, microclimate, soil fertility, soil drainage, and soil disturbance. For the purpose of this discussion, the forest formations will be described at the series level. Series are groups of plant communities having a common dominant tree species in the climax state. Three series occur on the forested lands of the Missoula SYU.

1. The Ponderosa pine series occupies the driest sites classed as suitable for intensive timber management. Ponderosa pine (Pinus ponderosa) is the most drought resistant species having commercial value. The series is normally found on dry south and west facing aspects, typically with an understory of bluebunch wheatgrass (Agropyron spicatum).

Douglas fir (Pseudotsuga menziesii) may occur as an accidental species throughout this series, although it is not able to reproduce vigorously enough, due to dry conditions, to replace ponderosa pine even after centuries without fire or other forms of disturbance. Good examples of this series are the pine stands growing on the south facing slopes of the Clarkfork River between Rock Creek and Drummond.

2. The Douglas fir series occupies sites situated higher on the moisture gradient than the Ponderosa pine series. Within this district, the difference between series is determined more from moisture levels than elevational changes. Of the three series, this one has the widest range in the SYU. It ranges from very warm-dry southern aspects through the cool-moist northern aspects. As can be expected, those sites found on the moister end have the best potential for intensive timber production.

Although Douglas fir seedlings have shorter tap roots and are more sensitive to drought, the tree will compete better than ponderosa pine in places moist enough for seedling establishment. In this second belt of forest where Douglas fir is the climax dominant, population structures show the ponderosa pine, lodgepole pine (Pinus contorta var. latifolia), and weatern larch (Larix occidentalis) playing the role of seral opportunists that readily invade deforested areas. Whether they invade before Douglas fir or

concurrently depends on which seed sources are available. Once the canopy closes in, only the fir can continue to reproduce. The upper limit of this series occurs where there is sufficient moisture for alpine fir seedlings to succeed, since where moisture is sufficient this species has even greater competitive abilities than Douglas fir.

Pure stands of lodgepole pine can be found over the entire range of the Douglas fir series, usually as a major seral species. When conditions are right (i.e., full sunlight and mineral soil or disturbed duff free from competing vegetation), this species is able to establish itself. The lodgepole is a prolific seed producer with trees less than 10 years old producing viable seeds.

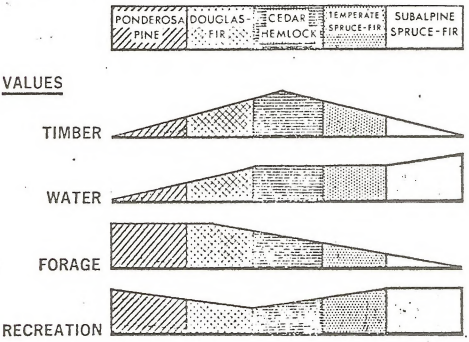
Another highly valuable tree species occurring on select sites within this series is the western larch. This species is limited to the cooler moist northern aspect found along the south side of the Blackfoot Drainage from Bonner east to Lincoln. When the environment is compatible with the rather restrictive needs of western larch, it is a very productive species and one of the easier species to manage. The older, mature trees are wind firm, fire resistant, and prolific seed producers, making them well suited for leave trees in seed tree cuts. Larch is intolerant of shade except in the early seedling stage when it tolerates partial shade. Dozer scarification and burning are the most dependable methods for site preparation.

3. The Subalpine fir series (Abies lasiocarpa) is usually associated with higher elevations. However, the forest inventory identified this series from as low as 4800 feet up to 7800 feet. Subalpine fir indicates frost pockets or very cool climatic regimes when it occurs at lower elevations, i.e., a climatic climax.

Douglas fir, western larch, and lodgepole pine are major seral species in the "temperate zone" within this series, while Engelmann spruce (Picia engelmanni) is a major component of moister sites.

Within this series are some very productive sites, especially west of the Continental Divide. Generally speaking, the better subalpine fir sites are more productive for timber than the better Douglas fir and Ponderosa pine sites. As a rule, subalpine fir habitats are used by big game species as a summer-fall range.

The following figure shows the distribution of timber, water, forage, and recreation values by forest series in Montana. The Cedar-Hemlock and Subalpine Spruce-fir series occurs extensively in Montana but not within the Missoula SYU.



Approximately 70 percent of this SYU is in the Douglas fir series, 28 percent in the Subalpine fir series, and 2 percent in the Ponderosa pine series.

ANIMALS

Nearly every forested acre of the SYU provides habitat for some species of wildlife. Used in this context, wildlife is defined as all wild vertebrate animals.

1. Elk (Cervus canadensis), in terms of public concern, is the most important animal on these lands. Although elk are grazers and often compete with cattle for available grass, they are adaptable and in this area as much as 90 percent of the winter diet consists of browse from shrubs such as Ceanothus, serviceberry (Amelanchier alnifolia), chokecherry (Prunus virginiana). Elk prefer graminoids and their increased use of browse often indicates a change in diet caused by overgrazing by livestock. Although patterns vary, they tend to summer at high elevations and then migrate to critical winter range at lower elevations where snow is less likely to limit or eliminate available forage. Like deer, elk have the capacity to destroy their own food supply and in the process greatly reduce the carrying capacity and stability of their range. Other management problems involve their need for adequate winter range, escape cover, and protection from excessive disturbance.

2. Mule deer (Odocolieus hemionus) occur throughout the SYU. Although forbs and to a lesser degree grasses are important in the spring, summer, and early fall diet, in the critical winter period the mule deer's diet in this area is almost entirely browse. Use of browse by elk resulting from livestock conflicts may affect this relationship.

3. White-tailed deer (Odocoileus virginianus) are found throughout most of the SYU. In the southern part of the area (and east of the Divide, generally), most whitetails are found in deciduous

drainages, particularly those associated with agriculture. Important foods include maple (Acer spp.), serviceberry, and other browse species supplemented by lesser amounts of forbs and grasses.

4. Moose (Alces alces) are fairly widespread in the subalpine fir and Douglas fir types. Important foods include willow (Salix spp.), subalpine fir, dogwood (Cornus spp.), serviceberry and chokecherry.

5. Black bear (Ursus americana) are found all year in the Douglas fir and subalpine fir types, but they use other habitats when food (grasses, forbs, pine nuts, berries, etc.) become seasonally abundant. They do best where human habitation, logging, or agriculture have not altered the environment significantly.

6. Big Horn Sheep (Ovis cavadeusis), and Rocky Mountain Goat (Oremnos americanus), although not widespread, are found in the Ram Mountain area. These animals feed primarily on forbs and grasses.

7. Furbearers and predators, although no surveys have been made, that are almost certain to occur on BLM forest lands in the Missoula SYU include: coyote (Canis latrans), red fox (Vulpes fulva), cougar (Felis concolor), bobcat (Lynx rufus), raccoon (Procyon lotor), marten (Martes americana), long-tailed weasel (Mustela frenata), short-tailed weasel (Mustela erminea), striped skunk (Mephitis mephitis), beaver (Castor canadensis), wolverine (Gulo gulo), and muskrat (Ondatra zibethicus). It is possible that the following species also occur on the lands in question: fisher (Martes pennanti), otter (Lutra canadensis), and lynx (Lynx candensis).

8. Blue, ruffed, and Franklin's grouse occur on the areas being described. Blue grouse (Bonasa umbellus) are widespread in the coniferous forests and occupy a variety of habitats. After wintering at high elevations, they come down to semi-open timber in the

early spring for breeding and nesting. Herbaceous cover in forest openings is particularly important for brood security.

Ruffed grouse (Dendragopus obscurus) prefer denser cover of mixed conifer and deciduous trees and shrubs. They do not migrate as much as blues do and are often found along stream bottoms.

Habitat requirements of Franklin's grouse (Canachites franklini) are not well known. They use the denser forest types such as alpine fir and lodgepole pine.

Blue and Franklin's grouse feed primarily on conifer needles during the winter, while ruffed grouse use buds of deciduous trees and shrubs. Green plants, berries, and insects are important during summer, insects being the predominant food of young chicks.

9. Turkey (Meleagris gallopavo) are most frequently found in open ponderosa pine forests in rugged terrain. When available, ponderosa pine seed is the preferred food of turkeys, but a wide variety of foods are used including fruits, berries, leaves, grain and insects.

10. "A Distributional Checklist of the Birds of Western Montana" by Ralph L. Hand as compiled by Phil Wright, University of Montana, notes there are approximately 185 non-game bird species that have a potential of occurring in the Missoula SYU. The largest percent of these species forage in foliage for food, either insects or seeds. The insectivorous forms or species contribute the greatest share of the foliage-feeding element, with ground-foragers, timber-foragers, and air-foragers following in decending importance.

11. Fish on NRL in the SYU are limited primarily to small streams of the first and second order category with the average size of fish about 8 to 10 inches. Although most major species of trout

occur within the SYU, emphasis has been placed on management of aquatic habitat for west-slope cutthroat trout (Salmo clarkii lewisii), possibly an endangered species. The cutthroat readily hybridizes with rainbow trout (Salmo gairdneri), an introduced species to this state. Therefore, much of the "cutthroat" population may not exist in a pure strain. Efforts are currently being made to delineate any areas of pure strain west-slope cutthroat trout in these small streams.

12. Reptiles, amphibians, insects, etc., are represented on the lands in question by species typical of the several habitats involved.

13. "Endangered" species listed by the U.S. Fish and Wildlife Service and the State of Montana include the peregrine falcon (Falco peregrinus anatum) and the northern Rocky Mountain Wolf (Canis lupus irremotus). It is unlikely, however, that these species occur on the lands in question. Nevertheless, the possibility of recent wolf or peregrine sitings and suitable peregrine habitat (cliffs) should be checked out for each individual timber sale. Grizzly bear (Ursus horribilis) is classified as "threatened" and is found in northern Lewis and Clark County as far south as Rogers Pass on Highway 200 and in northern Powell County in the vicinity of Margum Mountain. In areas which the U.S. Fish and Wildlife Service designates as "critical habitat," all agencies must insure that their management activities do not diminish grizzly habitat.

14. A list of other non-game species of special interest and concern is being prepared by the Montana Fish and Game Department. Mammals and amphibians listed for the counties included in the SYU (Powell, Granite, Lewis and Clark, and Missoula) include the following: California myotis (Myotis californicus), long-legged myotis (Myotis volans), fringed myotis (Myotis thysanodes), Townsend's big eared

bat (Plecotus townsendii), wolverine (Gulo luscus), mountain cottontail (Sylvilagus nuttalli), Malheur shrew (Sorex preblei), least weasel (Mustela rixosa), tailed frog (Ascaphus truei), Pacific giant salamander (Dicamptodon ensatus), van Dyke's salamander (Plethodon vandykeii), and the bull frog (Rana catesbiana). In the near future, this list will be extended to include birds and reptiles.

The biotic and abiotic components were covered separately in previous sections. This section looks at these components together as they interact to form a forest ecosystem. The word ecosystem describes a natural unit of land or water and all the living organisms and non-living materials found there. It has a lengthy definition, can be defined broad or narrow, but most of all it is a concept. The concept means that organisms and environment are interrelated. More specifically, we can put this in terms of (1) plants, (2) animals, (3) climatic factors, and (4) edaphic (or soil) factors. They are in equilibrium, and a management action applied to one of these will affect the others and change the equilibrium. An ecosystem is composed of living organisms and the physical environment of these organisms. The climate and soils make up the physical environment, relatively unchanging. The plangs and animals are dynamic--plants in a successional sense and animals as a mobile element. The climate and soils (the physical environment) are the habitat for the plants. They cannot move physically and the plants that grow in a certain area are a reflection of the physical environment. The animals, however, do not have that direct a relationship to the physical environment. The animal habitat consists of the physical environment plus the vegetation and the particular stage of succession that the vegetation is in.

Green plants are the producers in the ecosystem. For this reason, the condition and quality of vegetation is an important consideration in the management of land. The other living organisms in the system are consumers; they live on the food material manufactured by the plants or they consume the animals which eat the plants.

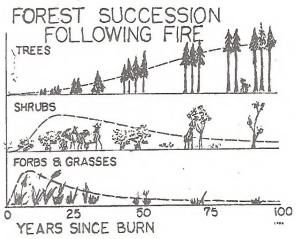
A very close relationship exists within an ecosystem and each different ecosystem has limits to its capability to withstand disturbance. It is sensitive to the removal of plants, disturbance of the

soil, pollution, and sometimes even man's presence. If we demand too much from an ecosystem, its productivity will decline.

The Missoula SYU forest ecosystem is a mosaic of age classes and species. This situation tends to create and maintain diversity in the ecosystem. This is good because a basic principal of ecology is that diverse ecosystems are much more resistant to attack than ecosystems in which genetic variety has been cut to a minimum.

In other words, the forest lands within the SYU represent a series of successional stages. Each stage is accompanied by a variety of species numbers and composition of both flora and fauna.

The following diagram illustrates a hypothetical model of forest succession following fire. The successional sequence can be extrapolated to cover the disturbance caused by silvicultural practices.



Probably one-third of the forest ecosystem on national resource lands in this SYU have been disturbed by fire, logging, or mining in the past 75 years. Livestock grazing has occurred on almost every area in the SYU. Much has been overgrazed to the extent that a dis-climax or

zootic climax is created. A zootic climax does not affect the existing overstory, only the understory. It may, however, seriously reduce or prevent coniferous reproduction. This situation occurs most frequently in the Douglas fir series.

Natural and man-caused disturbance are no strangers to the Missoula SYU forest ecosystem. Logging on the intermingled private ownership and a long history of mining have contributed to a road system that puts most of the Bureau's commercial forest stands within one mile of a road. The few areas that are not in this category have been withdrawn from the allowable cut base for further study during this first allowable cut period.

Watersheds are stable although there were a number of damaging run-off problems during the springs of 1973 and 1975. These problems were not totally caused by over-cutting and over-grazing; however, these factors were partially responsible.

Nutrient flow in a forest ecosystem can be expressed as a budget consisting of nutrient flows, cycling within the forest ecosystem (storage), and outflows. Nutrients are supplied to the forest ecosystem in precipitation, from weathering of the bedrock and, in some cases (such as nitrogen), are fixed directly from the atmosphere by soil organisms. Nutrient cycling within the forest ecosystem is a dynamic process whereby nutrients stored in the soil are taken up by plants and other organisms and held until death and decomposition complete the cycle. Some nutrient outflow can occur by volatilization; however, most occurs by solution in streamflow and by absorption on mineral and organic sediments.

AESTHETICS

Because of the variety of forest areas included in the timber management plan, discussion in this section is necessarily general. EAR's on individual timber sales will identify specific landscape types and analyze the influence of the proposed actions on existing landscape harmony and accentuation.

The areas included in the timber management plan are primarily forest types, including the ponderosa pine, Douglas fir, and subalpine fir series. The character of a particular landscape depends on the species and age composition of the stands, the expanse of the view, the steepness or ruggedness of the associated mountains, the presence of other associated features (streams, cliffs, rock formations), and the extent of human intrusions (logging, agriculture, mining, urbanization). Adjectives describing many of the landscape types include inspiring, rugged, and vast. Other landscapes are subtle, moody, and fragile.

The landscapes of the areas in question are generally harmonious. That is, their various features tend to relate to each other in an orderly and pleasing manner. Some views include accentuating elements (streams, ponds, rock outcrops, etc.) which heighten landscape quality by contrast. In some areas, intrusions in the form of roads, residential areas, logging operations, and powerlines reduce the quality of landscape character from the point-of-view of most observers.

Areas containing unique geological structures are rarely found in the Missoula SYU. However, two sites which do exist are the Warm Springs Creek Falls and the arch-like formation guarding the entrance to the Wet Mulkey drainage.

PREHISTORIC AND HISTORIC FEATURES

Already located prehistoric sites in the Missoula SYU indicate a rich prehistoric resource. Sites occur on both sides of the Continental Divide, dating back to earliest documented occupations of North America by prehistoric peoples. Dating on these sites indicates occupation of the area as early as 10,000 years ago. Other sites show prehistoric use of the area through time until the beginning of the historic period in the 19th Century, A.D. The prehistoric sites are significant documentation of man's early use of the area included in the SYU. Documentation of these known sites is on file at:

1. BLM's Montana State Office, Billings, Montana
2. Montana State University, Bozeman, Montana
3. Montana Statewide Archaeological Survey at the University of Montana, Missoula, Montana

The above sites were discovered accidentally without systemmatic effort. Many more sites are likely to be discovered when systemmatic archaeological inventory has been conducted.

Many old cabins, ghost towns, abandoned mining camps, and old wagon roads lie scattered throughout the area. Some of these are documented in the Western Interstate Commission for Higher Education's 1972 publication "Historical Resources Identifications and Location Study." Further research is being conducted under contract by Western Interpretive Services of Sheridan, Wyoming. Some of the sites identified by these two studies are or will be candidates for the National Register of Historic Places. The EAR process for individual timber sales will include verification that Federal law as pertains to historic places is complied with.

SOCIO-ECONOMIC CONDITIONS

Unless otherwise indicated, data presented in this section are either from the County Profiles put out by the Division of Research and Information Systems, Montana Department of Intergovernmental Relations; or are taken directly from the data of the U.S. Department of Commerce, Bureau of the Census.

Although the Missoula SYU includes 10 counties, only four--Granite, Lewis and Clark, Missoula, and Powell--contain National Resource Lands. Therefore, the data presented in this section will focus on these four counties with comparisons, as appropriate, with statewide totals.

The 1970 combined population of the four counties was 100,960, up 22 percent from 1960. During that interval, the state population increased only 3 percent. Of the four counties, Missoula County is by far the largest, with a 1970 population of 58,357, and experienced the largest growth during the 1960's--31 percent. Lewis and Clark County gained 19 percent to 33,281, while both Granite and Powell Counties (which had 2,876 and 6,455 inhabitants, respectively) lost from 4 to 8 percent. Compared to a statewide population density of 5 per square mile, the density of Missoula County is 22 per square mile, Lewis and Clark 10, Powell 3, and Granite 2.

With the exception of Granite County, which is credited with no urban population, the population under consideration is relatively urban--70 percent, as compared to 53 percent for the state as a whole.

Unemployment for the four counties in 1970 was 7.4 percent, slightly above the 6.0 percent average for the state. In the individual counties, unemployment ranged from 7.6 percent for Missoula to 4.7 percent for Powell. The wood products industry provides about 14 percent of the industrial employment and produces about 19 percent of the earnings by

industry in eight of the ten counties of the district. (USDC, Office of Business Economics, Regional Economics Information System, unpublished data, Washington, D.C., February, 1972.)

Locally, timber production from the Missoula District's intensive timber management lands has accounted for the largest economic contribution of its various resources. Using an annual harvest cut of 7 MMBF for the 10-year span of this larvest plan and the income and employment multipliers set forth by Maxine C. Johnson in the spring, 1972 issue of "Montana Business Quarterly," we can approximate the dollar value of the timber resource and the effect this proposed harvest plan will have on the local economy.

If we assume the harvest and milling of one million board feet of timber requires the activities of about 8 persons/year[1], then 7 MMBF annually should employ 56 persons/year.

Per capita personal income ranged from $2,773 for Granite County to $4,036 for Lewis and Clark County, and averaged $3,499 for the four counties. The statewide average was only $2,712. Median family income ranged from $7,123 in Granite County to $10,254 in Lewis and Clark County, the statewide average being $8,512. The percent of families below the poverty level was 10.3 percent statewide, and ranged within the four counties from 6.5 percent in Lewis and Clark County to 12.3 percent in Granite County.

For western Montana, Maxine Johnson lists the employment multiplier as 1.78 secondary jobs for each primary job. Applying this expander factor to our 7 MMBF of annual cut, it should provide employment for 100 persons/year in secondary industries.

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1. "Montana Business Quarterly" prepared by Maxine Johnson, spring 1972. Revised by Johnson in 1975.

In Maxine Johnson's analysis of the wood product industry, she based a lot of her income and job related data on 1969 statistics. Her reasoning was:

> "Even though 1969 may seem long ago to some readers, it is a rather good choice of a year in which to evaluate the wood products industry in Montana. The year 1969 is fairly representative of recent years, when the industry reached a high point in employment and production. It was not as prosperous a year as 1968 (prices fell in 1969 as housing construction declined), but it was better than 1967 and 1970."

For the sake of continuity, our income data will also utilize 1969 figures. The average index price for Douglas fir in 1969 was $102.88[1] MMBF. Applying this figure to our 7 MMBF of annual harvest yields a net worth at the lumber year outlet of $720,160. Applying Maxine Johnson's multiplier effect for the western Montana counties of 2.29 percent, the gross realization value to the communities is $1,649,160.

One final monetary comparison of interest in the stumpage value or gross income to the Bureau of the proposed annual harvest level. Again using the 1969 data and the resulting stumpage value of $8.34/MBF, we can arrive at a gross stumpage value of $58,380 for our proposed 7 MMBF of annual harvest.

Formal attitude and expectations surveys specifically about timber management have not been conducted within the district. However, data collected by the State of Montana, Department of Natural Resources and Conservation, Energy Planning Division (Montana Energy Survey, unpublished, Helena, MT, November, 1974), is relevant. This survey made several statements to which those interviewed were asked to respond. Three of these statements were: (1) The industrial development of Montana should be encouraged, (2) If new industry is to be built in Montana, it should be directed to areas in the state that are already industrialized, and (3) In order to live in Montana, I am willing to

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1. Source: Western Wood Products Association, "Lumber Price Trends," March 3, 1972.

pass by opportunities for higher income that might be earned elsewhere. Each respondent was asked to indicate whether he strongly agreed, agreed, was neutral, disagreed, or strongly disagreed with each statement. The statewide sample of about 900 included some 130 respondents from Lewis and Clark, Missoula, and Powell Counties. (Granite County was not sampled.)

The three counties in the district that were sampled showed some marked differences from the state as a whole. For example, in the statewide sample, 42 percent of the respondents felt that the industrial development of Montana should be encouraged, while only 25 percent of those in the three counties felt that way. The second statement (above) elicited about the same response from the three counties as it did statewide--in each case about 52 percent either agreed or strongly agreed. However, only about 76 percent in the statewide sample agreed or strongly agreed with the third statement, while in the three counties, 83 percent agreed or strongly agreed.

The above data indicates that the people in the region affected by this EAR are more concerned about the impacts of industrial development than are Montanans generally. Although the survey did not treat timber management practices specifically, it seems likely that the people of the three counties are concerned about its impacts also. Within the counties, a greater proportion of the environmental concern is probably concentrated in Missoula. Smaller communities like Avon, Drummond, and Lincoln are greatly dependent on logging, agriculture, and ranching. People here are oriented to living directly with these practices as being vital to their economic survival.

The SYU provides the setting for a wide variety of recreational experiences and opportunities. Recreational use on National Resource Lands ranges from leisure pursuits in a primitive environment to more structured activities in a historical setting. Major recreation uses

include fishing, sightseeing (including exploring in old mining areas), camping, picnicking, snowmobiling, snowshoeing, cross-country skiing, and hunting.

Big game hunting is probably the most significant source of recreation for many residents of the region, and it attracts non-residents whose expenditures are substantial. In addition, non-consumptive uses--photography, animal observation, etc.--are increasing and many people are gratified by the knowledge that a given species is present even though it is not easily seen.

Portions of the SYU, primarily in the Garnet Range, are easily accessible due to a network of gravel and unimproved roads. Many of these roads were developed to serve mining claims and a major weekend pursuit is driving for pleasure, viewing the scenery, and "exploring" around remnants of old mining activities.

A system of snowmobile trails has been developed by BLM in and around the old mining town of Garnet. Protection and interpretation of Garnet has been proposed. As plans are implemented, use can be expected to increase.

LAND USE

Current land uses of BLM forest lands in the Missoula SYU include timber production, mining, water production, grazing, camping, hunting, and fishing. In general, these uses are compatible with adjacent land uses. The EAR's for compartment development plans, however, will analyze carefully the land use compatibility of the specific sites involved.

Currently, the BLM manages approximately 216,000 acres of NRL within the Missoula SYU. Not all of this land is commercial forest. Twenty percent is non-forested. Approximately 30,000 acres of forested lands are incapable of producing enough wood (less than 20 cubic feet per acre) to be considered commercial. One hundred forty-four thousand acres constitute the commercial forest land in the SYU.

NRL lands are mixed with large industrial and small private forest landowners, as well as other publicly owned lands. The tracts of BLM administered lands may be in relatively large blocks, but more frequently they are in scattered small tracts (less than 540 acres) or full sections arranged in a checkerboard pattern.

In general, current use of the lands in question is appropriate in terms of the natural land base. However, local exceptions are likely to occur and this possibility will be carefully investigated in the EAR's for compartments.

Extensive subdivision of private forested land in western Montana has caused both full and part-time residential occupancy intermingled with NRL. These people often expect that the natural environment of adjacent public land will not be disturbed and oppose intensive management.

CHAPTER 3

ENVIRONMENTAL IMPACTS

This section analyzes the effects of the various means which may be employed to execute the proposed action. This range of methodology represents the real "alternatives" which must be considered at the operations level. Documentation of the rationale for selection of certain measures and practices for a specific proposed action will be found in the supplemental EAR for that particular action.

An aspect covered by this document is the general cumulative impact of the many, relatively small actions that in total comprise the timber management program. Many of the discrete actions taken over a 10-year period may have a negligible impact. Where the general assessment does not cover specifics of a given timber sale, etc., they will be covered in supplemental analysis reports. The actual number of acres cut per year, total areas reforested or thinned, and roads built per year may vary considerably from year to year. In terms of volume and acres, the proposal sets 10-year levels. It is estimated that 80 miles of permanent roads and 20 miles of temporary roads will be required to remove 70 million board feet from 25,000 acres in the 10-year period being analyzed.

The analysis of impacts on each environmental component is organized according to the stages of implementation (cutting practices, yarding systems, transportation systems, development and protection).

CLIMATE AND AIR QUALITY

Forest regions are products of the general climate of the earth, over which man has no real control. However, to the extent that man can destroy or conserve forests, he does control some local climatic factors. Viewed in this light, the forests assume much greater social significance than they would have if thought of solely as an economic resource.

The climate in which a given tree or stand lives may be entirely different from the regional macro-climate. In recent years, much has been learned about the micro-climate--the climate near the ground, surrounding the trees. Timber management activities can impact the micro-climate.

Depending upon the extent to which they open the forest canopy, all cutting practices affect the micro-climate. The impact may be insignificant (light selection cutting), moderate (intermediate shelterwood cutting or commercial thinning), or great (extensive clearcutting). To varying degrees, each type of cutting increases solar intensity, air and soil temperatures, surface evaporation, and air movement and wind velocity; and decreases vegetative transpiration and relative humidity.

Reactions of the forest ecosystem to climatic changes are variable. Increased sunlight stimulates the sprouting and growth of branches on stems of trees; higher soil temperatures and more available soil moisture may accelerate tree growth; increased wind velocities may cause windthrow of reserved trees in a partially cut area or along the edge of a clearcut. Micro-climatic changes produced by canopy reduction can either favor or inhibit forest regeneration.

There may be short term emissions of pollutants from the engines of machines, and dust from yarding operations, which affect air quality slightly.

To the extent that yarding systems drag logs and otherwise disturb the understory vegetation, they may severely affect micro-climatic conditions of the plants and small animals that inhabit the specific areas of disturbance.

Right-of-way clearing for forest roads has impacts upon the local climate which are similar to those of clearcutting. Several of the road construction activities can cause temporary degradation of air quality by emission of engine exhaust fumes and particulate matter. Dust from construction operations may be locally heavy; its effect may be accentuated by increased movement of air and higher wind velocities in the corridors created by clearing. Transportation of logs by truck can degrade air quality along a forest road.

Methods of slash disposal, other than burning, have virtually no impact on air quality. Controlled burning, like wildfire, creates smoke. Much of the organic matter in smoke from forest fuels is similar to material naturally entering the atmosphere from living vegetation or from the decomposition of vegetative material. Research indicates that toxic compounds released into the air by burning forest fuels are negligible. There is no evidence that the combustion products of burning cause permanent injury to human health. These impacts usually occur in the fall during a 2-month period.

Controlled burning can affect the local forest climate. The effect of a light burn, confined to the forest floor or slash piles might not be significant. A hot fire, particularly a crown fire, can kill all vegetation, consume the organic material on the forest floor, and have severe impacts on micro-climate.

Reforestation by seeding and planting affect the micro-climate gradually, until crown closure is achieved and the forest canopy is continuous. Significant changes will occur:

1. The mean maximum monthly air temperature in the forest will be several degrees lower than it was in the open.

2. Forest soil temperatures will be slightly warmer in winter and 5°F to 9°F cooler in summer than in the open and freezing of forest soil, if any, will be less deep than in the open.

3. Relative humidity of the air within the forest will be 3 to 12 percent greater than in the open, and evaporation of moisture from the forest floor will be much less than from soil surfaces in the open.

4. Wind velocities within the forest would be much lower than those in the open.

Activities to control wildfire in forest stands would improve air quality.

As a result of any cutting practice, organic material will be added to the forest floor more quickly than it would naturally, barring catastrophic windstorms, etc. There will be a temporary reduction of soil nitrogen for plant growth because of this addition. The added material will afford more protection from raindrop erosion. Clearcutting and seed tree cuttings expose more of the soil to erosion forces than the other cutting practices.

The effects of yarding systems upon the soil are interrelated functions of types of soils, equipment, weather, and topography. For example, a soil may be severely damaged by crawler tractor logging during times of soil wetness. But the same soils may not be harmed if the same operation is conducted when the soil is frozen and protected by snow cover. The hazard of soil sterilization in small areas from fuel or oil dumping and spills is always present when motorized equipment is employed.

Aerial yarding systems generally have the least impact upon the soil; however, they are rarely used in the SYU. Impacts include road and landing construction, which can initiate soil erosion and sometimes landslides.

Yarding methods which generally have moderate impact upon the soil are horse skidding, rubber tired skidder, jammer yarding, and mobile yarder-loader operations. These methods require more roads and landings than aerial systems. They also disturb a larger percentage of the litter layer and topsoil. Trails where the logs are skidded become scraped and compacted. These two conditions concentrate water and provide areas for overland flow of water which can lead to rill and gully erosion.

Yarding methods which generally have a severe impact upon the soil are the crawler tractor and shovel yarding. Tractor yarding disturbs and compacts as much as 40 percent of the area. Soil structure is usually destroyed on frequently traversed areas and is more easily destroyed if the soils are wet. Surface runoff is the rule under these conditions.

Tractor yarding causes deep soil disturbance over 15 percent of the area, while moving cable yarding disturbs 1.9 percent of the area. Tractor yarding causes 5.9 percent shallow soil disturbance over the area, while cable yarding causes 13.3 percent. Shovel yarding, which is seldom, if ever, used now on BLM timber sales, requires a dense road network. Many more acres are exposed to erosive forces utilizing shovel yarding rather than yarding methods listed as having slight and moderate impacts.

Clearing and grubbing for transportation systems opens an area, removes the vegetation, and disturbs and exposes the soil to erosive elements. It can cause soil compaction, particularly on wet soils, and accelerated erosion.

The excavation of earth or rock from its natural resting place has several impacts on the soil resource. It alters the natural drainage from hillsides and exposes underlying soils to weathering action. It removes lateral support to adjacent material. On hillside cuts, it may unload a slope at a critical point and trigger landslides. Roadside cut slopes are bare, erodible watersheds which can increase sediment and drainage problems. Topsoil may be poorly disposed of or wasted.

Fills add weight ot the underlying soil mass, and on steep hillsides can trigger landslides or slip failures. Added weight of fill on faulty foundations can result in slumps and settlements. Newly constructed

fills have bare slopes which contribute to erosion and sediment until stabilized. Fills placed at a greater angle than the normal angle of repose are prone to failures.

Grading operations impact soils by cutting, smoothing and disturbing surface materials on roads, fill slopes, cut clopes, ditches, and other areas requiring shaping. These operations can cause erosion and sedimentation.

Topsoiling and seed bed preparation by tillage and discing loosens and disturbs the soil so that it may be easily eroded prior to turf establishment. Shoulders, fill slopes, slopes of ditches, drainageways, areas around drainage structures, cut slopes, other areas outside the rounded tops of cuts and toes of fills are possible erosion generators.

Ditch and fill slope erosion may occur. This erosion may result in the loss of productive soils, the clogging of ditches and drainage structures, and endanger the stability of side slopes in embankments and cut sections. Spillage of petroleum products or excess application may result in soil contamination.

Debris and slide removal practices impact the soil resource, depending on the method of removal (sidecast or removal to designated waste areas) and the location (stable or unstable) in which these materials are placed. Improper actions in removal and in relocating these materials makes them prime sources of material for soil erosion and stream sedimentation. Waste soil may ravel or creep downhill if steep slope gradients are involved.

While most actions related to timber management would have little, if any, adverse effects on geologic features, road construction could severely impact them. For instance, excavation of earth and rock during road construction could cause massive landslides or alter the natural "arch-like" rock formation near the mouth of Wet Mulkey Drainage.

A hot slash burn can consume the organic duff, slash, and brush, which still provide some shade for the forest floor, and thus expose the mineral soil to direct solar radiation. In some ecosystems, the result may produce a well-stocked stand of tree seedlings. In others, high surface temperatures or deficient moisture may inhibit the establishment of tree seedlings.

Burying slash causes soils to be exposed to erosive agents when the litter is removed. The wasted soil will also ravel or creep downhill if a steep slope gradient is involved. Chipping slash and spreading it back over the land will give additional litter cover and cause a temporary reduction in available soil nitrogen. Chipper equipment may cause soil compaction.

Scarification disturbs the protective litter layer and churns up the topsoil. These actions expose the topsoil to raindrop splash erosion and subsequent soil creep. Compaction of the soil, which reduces productivity, will result if scarification is done when the soil is wet.

Area burning causes a loss in some plant nutrients from the soil nutrient cycle. Some carbon, hydrogen, oxygen, nitrogren, sulfur, and about 30 percent of the phosphorous are lost during burning. Burning the organic matter also bakes the soil surface, reduces its ability to absorb water, and causes surface water runoff and erosion.

Spot burning intensifies the conditions outlines under area burning, sometimes to the point of soil sterility which lasts for a number of years.

Seeding and planting will protect the soils from erosion. Thinning results in an increase of slash on the forest floor, causes a temporary suppression of available soil nitrogen as it decomposes, and increases the potential intensity and rate of spread of wildfire.

The use of retardants to suppress fires is not detrimental unless there is a high proportion of an element such as boron. Tractor constructed fire lines expose the soil to erosion forces. Lines running up and down the slope expose the soil to conditions which may cuase serious erosion.

Right-of-way clearing for roads at creek crossings will expose natural water surfaces to continuous, direct solar radiation along short segments of streams. Direct solar radiation provides much of the energy required to raise water temperatures. However, this impact is not significant if it is limited to short segments of streams.

Clearcutting may cause sedimentation. This impact can be increased when broadcast burning is used in combination with clearcutting. Clearcutting and other timber harvesting methods may be beneficial in increasing the supply of water available for human use. Much research documents the potential of various cutting practices, properly applied, to increase water yields from forested watersheds significantly. Man-made openings in the forest canopy can cause the following effects, all of which result in increased runoff and more available water:

- increased accumulation of snow in openings;
- reduction of precipitation losses due to interception by the forest canopy and evaporation therefrom;
- reduction of soil moisture losses caused by transpiration of vegetative cover;
- increased water yield may cause a decrease in water quality, impact stream channels, and may cause flooding.

Falling and bucking of timber causes no degradation of water quality unless trees are felled into or across surface waters. Then, the lopping of limbs and sawing incidental to log making may deposit slash and organic debris in the water. This can cause the reduction of dissolved oxygen and impact aquatic life. Since it is required that all slash felled into streams be removed by hand, this impact is not significant.

All of the ground skidding and yarding methods have some potential for significant adverse impacts on water quality, since all cause some

degree of soil disturbance. The effect is most pronounced when clear-cuttings are yarded by tractor, particularly on slopes of 15 percent or more and on saturated soils. The resulting disturbance exposes mineral soil to surface erosion, with consequent sedimentation and turbidity of surface waters caused by materials carried downslope in runoff.

Shovel yarding itself is no more destructive than mobile yarder-loader operations. However, the shorter reach of the shovel makes a denser network of parallel roads necessary for effective shovel operations. If the road system already exists, the shovel can be used without much soil disturbance. If new roads must be constructed to support the jammer or shovel operation, much soil will be disturbed, probably with severe impact on surface water quality.

In areas of steep terrain, landings for logs are sometimes constructed by excavating level places where none exist naturally. The excavation may expose large quantities of mineral soil to the impact of rainfall, with resulting ravelling of embankments and downslope movement of sediments with surface runoff into natural waters.

Studies have shown that road construction associated with logging, rather than logging itself, is the factor which causes greatest surface erosion and mass soil movement, with resulting degradation of water quality. All of the road construction activities which involve surface disturbance or movement of earth and rock can cause degradation of water quality. These activities include clearing and grubbing, excavation and embankment, installation of culverts, quarrying, and grading.

The adverse effects are greatest when roads are constructed on steep slopes (over 50%) and excavated materials are wasted by side-casting. The excavated materials may be carried downslope into water-courses immediately by gravity or later by surface erosion or sliding and sloughing. Excavation for roads sometimes removes material which

supports unstable soils further upslope, with the result that the unstable soil mantle may later move downslope as a mass, sometimes damming a stream.

Construction of drainage ditches and bridges, and installation of gabions, etc., in stream channels can cause short term turbidity of streams while the work is being done. Contamination of water by grease, oil, and diesel fuel may also occur, if machinery used in these operations enters the water. Improperly installed culverts may discharge surface runoff onto fill slopes, eroding these slopes and carrying sediment into streams or lakes.

Forest access roads have traditionally been constructed adjacent to stream channels. In addition to those factors mentioned above, dust from passing traffic constitutes a source of sedimentation in streams.

Mechanical treatment of slash that involves the use of heavy equipment may result in soil disturbance and water pollution through erosion.

Broadcast burning can affect the quality of surface water. Hot slash fires that expose mineral soil to precipitation can result in surface erosion or mass wasting which, in turn, may cause sedimentation of forest streams. Severe burning can significantly increase sediment yields. The effect is emphasized on steep slopes in areas of heavy precipitation.

Sedimentation concentrations after hard burning may be many times greater than those observed on an undisturbed watershed. These abnormal sediment yields may persist for several years after burning, steadily declining as the exposed mineral soil becomes revegetated. Nitrate concentrations in stream water may increase following burning. Observations made so far would indicate that these concentrations will be far less than the limit of 10 parts per million recommended for domestic use, and well below any level deemed harmful to aquatic life.

The effects of area burning on groundwater are less well documented. However, it is known that high fire temperatures at the soil surface reduce water infiltration rates by producing a non-wettable (water-resistant) layer of soil immediately under the surface. The water-repellent layer lies parallel to the soil surface, and may vary in thickness from 2 to 4 inches. The presence of this barrier means that only a thin surface soil layer is available to store and transmit water during a rainstorm. Consequently, even in relatively light showers, the surface layer quickly becomes saturated, producing excessive surface runoff and erosion and, of course, stream sedimentation. Generally, any practice which increases overland flow will reduce groundwater recharge.

The indiscriminate use of heavy equipment in scarification can cause sedimentation and turbidity of lakes and streams. The magnitude of this water quality degradation will vary directly with slope, amount of precipitation, instability of the soil mantle, and area and depth of soil disturbance.

To the extent that protection activities reduce the occurrence of fire, favorable impact on water temperature and sedimentation will result. Suppression activities involving the movement of heavy equipment and the construction of fire lanes expose soil and cause erosion which can pollute water systems. In the rare event that a road is built specifically for future suppression, impacts on water quality would be similar to those discussed above.

Insect control programs may affect water quality as well as aquatic plants and animals. Primary methods would be accidental direct spraying of insecticide into surface waters, runoff into streams from sprayed areas, and through percolation of chemicals into groundwater.

VEGETATION

Certain timber management practices may be employed which result in varying levels of removal of vegetation. The primary impact is on tree species. Such an impact (removal) may be considered short term since revegetation usually begins soon afterwards with regrowth of residual plant species and invasions by species adapted to open conditions (pioneer species). These pioneer species may be herbaceous or wood vegetation, including tree species, depending upon the local situation. Timber management practices also have long term impacts in the form of time necessary to complete development of a new forest that resembles the one (completely or partially) removed. Even when done under ideal circumstances, the process takes many years. On poor sites, the vegetation process may be very slow. Long term impacts are also reflected in changes in species composition.

The impact of the various cutting practices is the disruption, through tree harvesting, of the upper vegetal layer and partial damage to the lower vegetal layers in the course of felling operations. Clear-cutting or seed tree cutting produce cutting edges where standing trees are exposed to wind. Subsequently, windthrown trees may endanger adjacent vegetation by providing a breeding ground for insects or fuel for wildfire.

Impacts of selection cutting are the least of any of the final harvest cutting practices, since a relatively small amount of vegetation is destroyed or removed. Selection cutting does not normally increase danger to forest vegetation from wind, fire, or insects because of the absence of large openings or heavy concentrations of slash over large areas.

All harvesting has some impact on tree species composition. Generally, species in early successional stages are varied in a given habitat type. True climax plant communities will not be common. In

shelterwood and selection cutting, tree selection which favors productive trees as a seed source may reduce the genetic variability of forest stands. With changing environmental conditions, this might increase the risk of mortality or cause a loss of stand productivity.

The impacts of commerical thinning and mortality salvage are relatively insignificant due to the minimal amounts of vegetation removed.

The short term impact of ground systems, such as tractor skidding, is the destruction or damage of undergrowth. Yarding can cause damage to residual trees resulting in rot, particularly in lodgepole pine and subalpine fir. Unless extensive soil compaction or loss of soil by erosion occurs, the long term impact is to contribute to a relatively early natural regeneration of tree species. Logging methods, such as horse skidding, do not greatly impact the herbaceous and shrub layers.

Road construction practices have a severe impact on vegetation. In addition to the actual removal of vegetation from the area, road construction frequently destroys vegetation over extensive areas below the road cut or fill where sidecast material (soil, rocks) is pushed by tractors, dumped by trucks, or blasted by explosives. Land covered by sidecast is often much slower to revegetate due to sterility of the material and depth to which it covers residual vegetation. Land covered by the road surface is permanently a non-producer of vegetation except for spur roads that are abandoned. Even the latter, however, will normally be incapable of producing vegetation similar to adjacent land due to their compacted condition. Dust from log hauling may adversely affect plant growth along roads.

Increased sediment from road construction and log yarding may create an environment conducive to aquatic plant growth. In other cases, if silt is heavy enough, it may kill oxygen producing aquatic plants.

In addition to their primary function of log transportation, roads provide positive long term benefits by serving as the means by which men and equipment may be moved into the forest to protect vegetation from fire and insects, to conduct reforestation efforts, and perform other management tasks.

The impact of the prescribed burning and mechanical treatment method of slash disposal are essentially the same as those of area burning and scarification discussed below.

The short term impact of scarification, mechanical brush cutting and area burning is a partial or complete destruction of vegetation. Spot burning of hand piled areas, chipping of slash, hand clearing, cleaning of competing vegetation, mulching, and snag felling have negligible impacts on vegetation. None of the remaining forest development practices damage vegetation. Their short term impacts are related solely to re-establishment, growth, and protection of vegetation. These practices include tree improvement, tree seeding, tree planting, baiting, and fencing.

All development practices have benefical long term impacts to the forest resource if they work as intended; trees will be regenerated early and grow at a fast rate, thereby developing a new forest without extensive delays. Some practices, however, may impact vegetation in the reverse of what is intended if misapplied. Examples include scarification that compacts soil, or removes soil or shrub layers that were providing conditions suitable for tree regeneration, and area burning that removes desirable shrub cover for tree regeneration, causes soil erosion or rapid invasion of other unwanted vegetation.

In general, adverse long term impacts from scarification and area burning are most likely to occur on relatively "warm-dry" sites within the ponderosa pine and Douglas fir series, especially where soils are

shallow and coarse, and the humus layer is thin or absent. Long term adverse impacts may also result from use of heavy equipment on wet soils, resulting in compaction. The possibility exists that tree improvement through genetics will produce trees that are over-specialized for rapid growth in a commercially desirable form, and under-specialized with regard to resistance to disease, drought, or other destructive agencies. Finally, tree planting or seeding can represent a tendency toward monoculture and the inherent instability of such ecosystems.

Protection measures benefit vegetation in the long term by insuring continuance of existing forest conditions. Fire line construction will destroy vegetation directly and also indirectly when excessive erosion occurs. Retardants have no significant adverse impact. Insect and disease control programs will have a beneficial impact on the growth of vegetation.

Nearly all wildlife would be initially affected adversely by the impact of timber harvesting. The modification of habitat, including food supply and cover, can and often does result in drastic displacement of individual animals. This displacement may be fatal if other suitable habitat is already occupied.

The majority of the impacts of timber harvest would probably be only of short duration (5-10 years). Many species of animals prefer habitats in less than climax stage. The area affected by cutting may extend beyond the cutting unit itself.

Logging slash is usually beneficial to ground squirrels, chipmunks, and lagomorphs. This material offers good escape cover for these species. Deer and elk respond adversely to high levels of slash. Second and third stage shelterwood cuts may be desirable for deer. This depends on the relative need for cover and forage. These areas can provide adequate browse, and slash disposal may be accomplished depending on the amount of reproduction present at the time of slash treatment.

Deer would probably respond favorably to clearcuts and seed tree cuts where slash is cleaned up adequately. Best response would probably be obtained after succession to an abundance of desirable browse species--sometimes five to thirty years following harvest of timber. Information on deer use of clearcuts in Montana shows a strong preference of clear-cuts in the 40 to 60 acre size range after slash has been adequately treated.

Studies of clearcuts in western Montana indicate that elk use is inversely correlated to the size of the clearcutting unit. Both deer and elk will tolerate higher levels of slash in smaller clearcuts. Both species are highly intolerant of natural windfall or slash under a

timber canopy adjacent to clearcut. Western Montana studies also show that in all cases both deer and elk use of clearcutting units appears to grow as vegetative cover approaches an optimum height; no noticeable change in use occurs thereafter. This height is three feet for deer and five feet for elk. Clearcutting may or may not be beneficial to elk and deer.

Those animals that would benefit from almost all types of cutting practices include hares and rabbits, pocket gophers, ground squirrels, chipmunks, mice, moles, and associated predators such as weasels and coyotes. The dead material on the ground could benefit black bear, because of the resulting insect food source. Opening of timber canopies would usually increase berry production, especially raspberry, choke-cherry, and elderberry, and sometimes huckleberries which may benefit black bear populations.

Larger herbivores may be beneficially or adversely affected by timber harvest depending on the practice used and the use made of the area by the animals prior to disturbance by logging. On summer ranges where security is limited, opening the vegetative community excessively will usually be detrimental. In areas of fall and winter range where food might be limited, the opening of the timber crown through logging may be beneficial, provided that the secondary impact of human occupancy is curtailed, and that opening the canopy does not increase snow depth and crusting sufficiently to make the browse inaccessible. Extensive cutting may reduce security values on winter range or the relationship of feeding and bedding areas.

Logging will produce changes in bird populations and, depending on the types of logging, will alter species composition.

The degree of cutting is directly related to the degree of impact on foliage feeders. Ground forage would be impacted by logging. Total bird populations density should return to precut densities within a year or two after cutting.

Hole and cavity nesting birds (woodpeckers, etc.) make extensive use of dead trees for nesting sites. Timber cutting, particularly clearcutting and seed tree cutting, may reduce available nesting sites for these birds. At the same time, openings in the forest may provide favorable hunting areas for raptors.

Small mammals and ground dwelling birds may be destroyed or displaced by a ground skidding operation. From the point of view of terrestrial wildlife benefits, horse skidding is the most beneficial--herbivores benefit from increased grass and browse production, while disturbance to ground dwelling species is minimized.

Probably the greatest adverse impact on wildlife would stem from road construction. As with timber harvesting, there would be initial sudden and disruptive effect on wildlife. Also, road rights-of-way would permanently remove acres of wildlife habitat and encourage harassment of wildlife through ease of vehicular access, and thus preclude use of large areas by certain species.

There are probably few wildlife species that would directly benefit from road construction and use. Obviously, some "edge" effect along roads is created in closed canopy environments that will be used by some species of birds and animals, but effects are still basically negative.

Organic debris deposited in streams from road construction and logging can reduce dissolved oxygen and impact aquatic life. Other impacts are damage to spawning areas due to sedimentation caused by road construction and increased streamflow caused by timber cutting.

Chipping, burning, or burying of logging slash would remove important cover for small ground dwelling or nesting mammals, birds, reptiles and amphibians, but benefit larger animals since it permits ease of movement and encourages the growth of browse.

Slash created from thinning will have a negative impact on browsing animals. Reduced tree density from natural stand conditions will increase undergrowth, providing more food in some habitat types. Thinning reduces the security value of a stand for wildlife and increases slash levels.

Scarification, hand clearing and cleaning, and area burning would have a temporary adverse impact on small mammals such as rabbits and mice, as well as deer and elk, by directly reducing food and cover sources and reducing the period between timber harvest and canopy closure. Burning would temporarily increase the nutritional value of the vegetation, and thus benefit herbivores in some cases, particularly on winter ranges.

Control of insects and disease would impact terrestrial wildlife through reduction of tree mortality and reduction of the food source for woodpeckers and other predators of the disease organism. It may also, in the case of burning and logging, produce a local increase in the quantity and quality of browse. As with most actions, some wildlife would benefit while others would be negatively impacted. Well-planned biological control measures would not have any significant impact.

Protection from fire can impact terrestrial wildlife. In general, species favoring the mature forest decline and species favoring the earlier seral stages increase following fire. However, if the forest already has sufficient openings and browse, herbivores would not benefit and may suffer temporarily from the loss of cover.

The nature of many chain-like relationships in the cycles and flows that link the components of the forest ecosystem are not known or understood. Some information, however, does exist for impacts of specific practices.

Logging and burning of the slash can temporarily impair watershed protection and increase overland flow of water and erosion of soil. Nutrient outflows will occur with this erosion and overland flow. Numerous studies including those reported by Debyle and Packer, 1972, in western Montana indicate that nutrient outflows represent only a small fraction of the nutrients available for plant growth. This increase of nutrients in the overland flow is not considered a hazard to water quality. These studies found that the increase in nutrients and sediment in overland flow return to pre-logging levels within two to five years after logging.

Timber harvest activities directly affect the nutrient cycling process by changing the amount of nutrients in storage. The nutrients stored in trees are, of course, lost from the site when the trees are removed. Besides carbon, oxygen, and nitrogen, calcium is the only other nutrient removed in any quantity. Carbon, oxygen, and nitrogen are also removed by burning vegetation. Calcium is the element lost in major quantities by the removal of logs. The magnitude of the impact on nutrient cycling is directly related to the severity of the harvest. Most studies reported involve only clearcutting. Fortunately, partial cutting would probably have negligible effects on nutrient outflows compared to clearcutting.

Successional patterns will be disrupted by timber management practices, especially harvest cutting. In the absence of disturbance, vegetative communities will move towards a climax plant association

which will perpetuate itself. Those forested acres that will receive cultural treatments will be harvested as the stands reach maturity. Old growth stands over rotation age will not occur in the managed forest. Although we may be managing a climax species, the condition of the forest will not be climax. However, by giving adequate recognition to the requirements of other ecosystem components such as through our snag management program, the adverse impacts of extensive timber management can be mitigated.

If the ecological relationships in undisturbed areas adjacent to treatment areas are in delicate balance, the relocation of animals or removal of vegetation may further extend the impact of the action. Therefore, the severity of the short term impact is not always localized to the directly affected area, but may extend to adjacent areas.

Generally, communities with high productivity in terms of the vegetal biomass can recover relatively rapidly. Communities with low productivity, i.e., plants with low growth rates and animals with low reproduction rates, are generally fragile and slow to recover. Consequently, the long term impacts of any of the development, protection, harvest, and transportation practices that destroy vegetation and/or cause extensive surface disturbance can be particularly severe on less productive sites.

While the physical impact of timber management practices on vegetation are readily visible, impacts on the micro-organisms that act as decomposers in the soil are indiscernible and perhaps more subtle. Nonetheless, they constitute a vital link in the trophic hierarchy, and their elimination or reduction due to chemicals or severe soil disturbance practices can also result in significant adverse short term impacts on the ecosystem.

Relative to the potential impact on the biotic components of the ecosystem, the impact of timber management practices on the atmospheric

components of the physical environment are considerably less. Although burning practices do release some particulates into the air, their impact is minimal in terms of human health. These particulates appear to have no lasting impact on the ecological relationships within the forest environment.

Even though the impact of any one practice on any one locale may be severe, its significance will probably be greatly diluted when viewed in the context of the size of the impacted locale in relationship to the size of the surrounding geographic area. Nonetheless, many practices are conducted in different parts of the forest at the same time, and in total can cause a severe cumulative impact to the ecosystem of the general area. Individual practices, including those having little adverse impact, continuously carried out over time can have a significant cumulative adverse impact on the ecosystem at some point in the future.

With few exceptions, the impacts of timber management practices on landscape character are adverse. Impacts of greatest magnitude are visual; but sound, odor, and mood are also involved.

The harmonious element is most often impacted. Cutting areas are unnatural when viewed close up or at a distance if they do not resemble natural openings. The visual impact of roads is an important part of the general appearance of cutting areas. Cutting areas can provide some variety to a landscape which may be beneficial in the long term.

Any action that produces a visible change in the natural forest environment can cause an adverse human reaction. Among development actions with highly visible effects are prescribed burning of slash (atmospheric smoke, charred forest floor); scarification (dust during the operation, disturbance of surface vegetation and soil); and pre-commerical thinning (slash). Noticeable evidence of protection actions includes fire lines and, if identified as such, the burned areas.

Cutting practices, logging and road building, are attracting increasingly critical public notice. The visual impact of clearcutting is particularly severe. Some logging operations, and particularly subsidiary road construction, create visible soil disturbance and atmospheric dust. Heavy log truck traffic over dirt or gravel roads may create clouds of dust which seriously impair visibility. Any timber management activities may leave residual litter as evidence of humam presence on the land.

Reaction to the unsightly effects of timber management actions will vary in intensity with the individual viewer. The range of human attitudes does not lend itself to a discrete classification on a graduated scale. However, some interest group reactions can be considered generally typical:

- Members of a community dependent on a forest-based industry are more inclined to accept the adverse visual impacts of timber management actions.

- Hunters, fishermen, rockhounds, berry pickers, family type campers, and off-road vehicle enthusiasts tend to appreciate the easy access to the back country provided by logging road networks. This appreciation may or may not outweigh the individual's objections to unsightly conditions created for forest development and timber harvesting activities. Emotions may be mixed.

- Backpackers, wilderness advocates and some hunters and fishermen, usually prefer the forest environment in its original condition, without man-made modifications. These people may react most strongly to any unnatural change in the landscape. They often oppose proposed roads which would open back country areas to vehicular travel.

The adverse visual impacts of timber production are partially offset by some incidental visual benefits. Sometimes logging road construction opens up an impressive scenic vista which otherwise would be unappreciated. Clearcuttings and vegetative erosion control measures along roads produce forage which makes wildlife more available for easy veiwing by amateur naturalists.

Sound, odor, and mood are also part of the landscape character. Even gregarious campers would tend to avoid proximity to a noisy logging operation or mechanized forest development project. Certainly a hunter would avoid such a locale; a fisherman seeking mental relaxation would, too. The diesel fumes and dust from such operations would be unpleasant to most recreationists. The combination of sound and odor could shatter the mood of the soul-seeking wilderness advocate.

Logging and roadbuilding may destroy or impair the visual value of geologic formations. In some cases, roads may expose geologic values of interest.

PREHISTORIC AND HISTORIC FEATURES

Timber operations can be very destructive to archaeological and historical sites and values.

Archaeological sites are most valuable to both the scientist and the sightseer when they are undisturbed. Actions such as road excavation, quarrying, and site preparation activities which disturb the soil on or around archaeological sites will reduce or destroy their values. Roads into areas of archaeological significance could create major impacts by providing easy access to vandals and looters.

Severe disturbance or alteration of the vegetation near historic sites will disturb the visual setting and weaken these human interest values. Soil disturbance or alteration of the landscape by road construction and site preparation for reforestation of cut-over areas can obliterate the remnants of years gone by. Road access into historic sites can subject them to vandalism.

No significant adverse effects of employment are felt to be associated with the proposed action. The market fluctuations in the timber industry do affect rates of employment, particularly in wood processing and manufacturing; however, this is not an explicit program impact. On the other hand, there are obvious beneficial effects on employment. Many jobs are created as a direct result of the timber management program. Other jobs, performing services for the timber related employees, are also created. In terms of the economy of Missoula and western Montana, the impact of the proposed action is generally insignificant, due to the small volume involved in the program when compared to the total volume processed by the forest products industry. However, it may be very important to smaller mills and logging operators in smaller communities in the SYU. In setting a program level for a 10-year period with an indication of future harvest levels, there is a stabilizing impact concerning the unit's contribution to the timber industry.

The proposed timber management program will have little effect on mineral activities. To the contrary, mineral activities pose a threat to the timber management program in that the mining laws allow prospecting in areas which have received intensive site preparation and reforestation.

Implementation of some of the proposed practices may restrict the use of NRL to some grazing permittees and lessees, temporarily or permanently; e.g.:

Various cutting practices (particularly clearcutting) can create more livestock forage. However, grazing may conflict with the silvicultural objectives chosen for treated areas.

Roads built for log transportation may impair a livestock producer's full utilization of NRL or of his own private lands. Log truck traffic can injure or kill domestic livestock. On the other hand, these roads may become stock paths to otherwise inaccessible ranges.

Short term or permanent losses of forage and other impairment of range livestock operations attributable to the timber management program are insignificant in the overall production of meat to satisfy national needs. However, these adverse impacts may be highly significant to the individual livestock producer.

Human health and safety can be affected by some forest development practices. Smoke from slash burning may have temporary adverse effects on people with respiratory problems. Visibility, at times, may be restricted where slash burning occurs near roads and highways, creating hazardous driving conditions. These conditions may also occur in conjunction with quarrying and rock crushing activities associated with road construction.

Where logs are being hauled out of the forest, there is always the danger of collisions with motorists and others using the logging roads.

Hazards to the health and safety of workers, both government and industry, can occur in practically all phases of the timber management program. Accidents leading to death and injury most commonly occur during harvesting and removal operations.

The proposed action will have a generally favorable impact on public attitudes and expectations about BLM timber management. The program has been developed with continuous public involvement. People expect an environmentally sound timber program and see the proposed practices as meeting that goal. Despite the general agreement, there will be specific actions proposed which will not be agreeable to some people.

The variety of recreational values and the broad array of timber management practices makes some land use conflicts inevitable. Although some recreational activities may be benefited by the timber management program, others will not. Quite often a practice may be both beneficial

and detrimental at the same time, the choice being dependent upon the user's point of view. As an example, for many years following logging, a cutting unit may have lost all apparent value to a camper or hiker. However, its invasion by vegetation may produce forage for wildlife, making the area attractive to hunters and berry pickers. As another example, surface runoff from a newly constructed, unstabilized forest road will cause varying amounts of turbidity and sedimentation of streams, with adverse effect on fishing success and water sports. The same road may provide access for hunters, berry pickers, rockhounds, bird watchers, campers, and prospectors.

Timber management practices may result in adverse public reaction, particularly in areas of heavy recreational pressure (usually near population centers); in situations involving unique or rare ecosystems or scenery; and where natural attributes create a high recreation potential.

Timber harvests can reduce the compatibility of timberland with adjoining land uses. For example, owners of summer homes may feel that the view from their home sites has deteriorated because of timber harvests. Campers may be disturbed by the noise and activity of an ongoing logging operation. This section should be given considerable thought in the analysis of impacts of individual timber sales.

Compatibility was considered and allowed for in the land use planning process. Subsequent development of adjacent private land for cabins, homesites, or other uses may create impacts on BLM timber management programs. The BLM programs may not be compatible with new uses of adjoining private lands. Improper logging of adjacent land may adversely affect BLM forest management through watershed damage and increased hazards from fire, insects, and disease.

Since timber harvests, particularly clearcuts, drastically change the character of the land, its suitability for certain activities can be affected. For example, removal of large old growth timber may render the area unsuitable for hiking and wilderness-type experiences while changing its value for water production and certain wildlife species. The areas being considered here for timber management are those areas where timber management will be a major consideration, reflecting the resource allocations made in the land use plans.

Forest habitat typing is a method generally used to determine what practices will be successful for a given site. Failure to consider individual site characteristics may result in application of practices that will be unsuccessful or reduce productivity on individual sites for timber and other values.

CHAPTER 4

MITIGATING OR ENHANCING MEASURES

Keeping in mind the diversity of specific sites involved in the action, the measures listed will be taken on individual forest management operations in the SYU. It is unlikely that all measures will apply to any one area, and subsequent evaluation of individual action may prescribe additional measures not considered in this level of analysis. The process of specific management planning by compartment along with an EAR is an integral part of the timber management plan. It is the flow of measures from individual assessments into contracts for timber sale and forest development that best assures minimum residual impact.

A problem in applying some mitigating measures involves the private lands intermingled with NRL. This is particularly true in considering watershed and wildlife values. The plan assumes close coordination with adjacent landowners. Knowing their plans will enable BLM personnel to better plan timber management activities and write compartment development plans. Cases may arise where the cumulative impact of a private landowner's operation and subsequent BLM proposals will be unacceptable. The BLM will have no choice but to deter or abandon the proposals, depending on the impacts involved. The BLM would have less control in the reverse situation, where BLM action came first, and the private landowner failed to follow reasonable practices to keep cumulative impacts at an acceptable level.

If the site is dry and exposed to solar radiation and drying winds, the cutting practices employed must provide shade which would reduce surface soil temperatures and evaporation. In forests susceptible to windthrow, cutting units should be designed so that strong winds would have minimum effect on the edges of the reserve stand exposed by harvesting.

The effect of right-of-way clearing upon the local climate can be reduced by keeping the width of clearing as narrow as possible, consistent with safety and adequate visibility. Dust arising from construction may be reduced to some extent by watering of subgrades during blading and surfacing operations. Dust from log hauling by truck can be abated by oiling roads or surfacing them with a dust pallative. On dirt or gravel surfaced roads, periodic application of water may effectively reduce the dust problem, particularly in areas where safety or damage to crops is a problem.

Smoke from burning slash will be mitigated by integrating burning schedules with weather reports to produce as fast and hot combustion as practicable and facilitate movement of smoke away from populated areas. Burying slash and chipping reduces the volume of fuel to be disposed of and thus reduces the need for burning and the resulting smoke emissions. However, both burying and chipping are rather costly measures and are not commonly employed, except for the burying of right-of-way slash which is becoming a more common practice. More intensive utilization of felled timber holds promise for future abatement of the smoke problem. In situations where prescribed burning of slash is essential, and considerable impacts from burning are anticipated, the following mitigating measures may be used:

- Adverse impacts will be reduced by keeping the areas to be treated small. The growing trends towards fewer and smaller size clearcuts and seed tree cuts favor this means of mitigation, particularly in the case of area burning. The beneficial effects of dead shade, where desired, will be retained by only spot burning slash concentrations that must be removed.

- If a light burn would achieve silvicultural objectives, its application can be timed for a period when burning conditions would favor an easily-controlled fire of low intensity.

Clearcutting and, to a lesser degree, seed tree cutting practices shall not be carried out on slopes where the potential for excessive erosion or mass failure exists. Factors affecting slope stability which should be considered include slope gradient, thickness of the soil mantle, character of the underlying bed rock, precipitation patterns, and the inherent strength of the soil. When these factors appear critical, other cutting practices will be considered. When these other practices, such as selection, shelterwood, etc., are not feasible due to silvicultural, economic, or technical constraints or the fact that the potential hazard remains despite the system of cutting employed, the area will be exempted from commerical timber production. Geologic and erosion hazards will be inventoried as a part of compartment development planning.

Tractor logging will be limited to slopes with average gradients of less than 40 percent regardless of the potential of the soil for compaction. Tractor skidding will be limited to those seasons and sites where soil moisture is low enough to avoid compaction, rutting, or gouging of the soil. Rehabilitation of skid roads will be required. Operators will not be permitted to clear a skid road for one or two trees. Since shovel yarding requires a closely spaced network of roads (250 feet apart), adverse impacts can be reduced by confining these operations to existing road systems; i.e., if new roads must be constructed, alternative logging methods will be used. Landings will be located so as not to create excessive sidecast or slope stability problems. Landings on highly productive sites will have the topsoil stripped and stockpiled. After use, ripping may be necessary to mitigate soil compaction, and the stockpiled material will be redistributed over the landing.

Road alignment and design have important effects on roadside erosion, and effective control must begin in the design phase, since the location

of a road determines to a large degree the amounts of erosion which may occur. The selection of the road corridor provides the opportunity to place a road in favorable relationship to topography, drainage ways, soils, other natural features, and present or anticipate man-made features in order to minimize the base erosion potential.

Clearing and grubbing limits will be staked so as to minimize the area of soil disturbance. Clearing and grubbing will not be carried out during periods of wet weather and poor soil conditions. Cut slopes and ditch gradients will be flattened in order to reduce the number of cuts, thereby reducing erosion hazard. Borrow areas will have the topsoil stockpiled, be shaped to natural contours, have the topsoil redistributed, and be revegetated.

All fills higher than 30 feet will be designed in accordance with established principles of soil mechanics. Construction of embankments will be done by placing the earth in layers and rolling to a specified density, usually in the range of from 90 to 100 percent of standard AASHO maximum density, before applying the next layer. As a result, the stability of shear resistance of the soil will be increased, permeability or water entry is decreased, and settlement of the embankment is minimized.

During earthwork operations, areas of bare soil exposed to erosion will be shaped to minimize storm runoff. Methods of control could include such devices as silt basins, sedimentation ponds, berms, and temporary down drains, swales, ditch pits, and brush barriers. Drainage channels will be constructed early in the grading operation.

Ditches will be kept cleared, culverts unplugged, and drainageways open. Spur roads that are outsloped will be cross drained and have berms removed on the outside edge except those intentionally constructed for the protection of road grade fills. Before spring runoff begins, all ice and snow berms created on winter haul roads will be removed. Gully erosion in waterways and ditch bottoms may be repaired by filling, shaping, and lining with riprap, etc.

Debris and slide material will be end-hauled and deposited on a safe bench or cover location well above the high water level. Disturbed areas will be shaped, tilled, and seeded with deep-rooted legumes and grasses to hold the soil in place and mulched, or some other stabilization practices used.

Drainage should never be allowed to dig its own channel. In preparing the road subgrade for surfacing, the material will be redistributed evenly, not scraped over the edge where it may erode into the established ditch. The road grade will be established at least 5 feet above the water overflow level in wet areas and areas subject to overflow.

The stabilization procedures for erosion prevention include grass seeding or hydro mulching of cut and fill slopes, borrow pits, landings and skid roads, with SCS approved seed mixtures suited for the locale. Due to the small size and scattered nature of these projects, the use of a hand operated broadcast seeder has proven the most suitable. The best time for broadcast seeding is either late fall or early spring while the site has a snow covering and as soon as possible after the disturbance has occurred. Some sites, like temporary road beds having compacted soils, need some form of mechanical site preparation to break up the compacted surface.

Erosion of the road surface will be minimized by performing proper maintenance grading and shaping and by patching and filling holes and irregularities. Mitigating measures as prescribed by the district programmatic road maintenance EAR will be taken.

To facilitate revegetation, trenches for burying slash will be constructed with the topsoil stockpiled and respread on the surface, after the trench is filled. The burning of slash will not take place on shallow or erosive soils when conditions are such that a "hot" burn will consume all the litter layer. Broadcast burning will be avoided.

Mechanical scarification for planting will be conducted when the soil is dry and limited to the area necessary to accomplish the task.

Fire lines will be constructed on the contour when feasible and subsequently water-barred and revegetated. The fire line can be scarified to loosen compacted soil if the line also served as a trail for vehicles.

The most effective measure to minimize the impacts on water resources is to analyze the cumulative effects of cutting in a drainage in terms of increased runoff. A common approach utilizes what is known as the "Equivalent Clearcut Area" and determines a vegetative rate of recovery on cutting areas in relation to water yields. Watershed stability is analyzed in each compartment development plan. By monitoring the timing of new cutting areas in relation to revegetation of older cuts, the increase in water yield (and corresponding decrease in quality) will be held within acceptable limits for any drainage area. This monitoring will include all other ownerships as well. Water quality will be monitored before, during, and after logging near perennial streams.

The adverse effects of clearcutting and seed tree cutting on water quality will be mitigated by providing streamside buffer strips of adequate width and density to reduce or eliminate sediment laden overland flow from reaching stream channels. All perennial streams and those streams which carry water during peak runoff seasons will have buffer strips. Buffer strips will contain enough trees and shrubs to provide shade for the stream and protection for the streambank. The width of the buffer strip necessary to meet these objectives will consider the slope of the ground into the stream channel; topographic shading; tree height, density, and species; stream characteristics (width, depth, and flow velocity); erodibility of the soil; groundwater levels; and precipitation patterns.

If these factors are critical and the success of the buffer strip appears questionable in mitigating the impact of clearcutting, other cutting practices will be considered.

It is extremely important that debris be removed from stream channels concurrent with logging. Channel clearance will not be deferred until just before the timber sale contract is terminated.

Falling timber upslope or along the contour of steep slopes will prevent felled trees from shooting downhill and into or through streamside buffer strips. If possible, trees cut selectively adjacent to natural waters will be felled directionally away from the water.

Areas adjacent to streams frequently are more fragile than adjacent slopes. Selected removal of timber in this zone will also dictate the proper yarding methods which might be different than the rest of the sale area. "Cat" skidding is generally not acceptable; some other method that creates a minimum soil disturbance is needed. Tractor skidding will not be permitted down or across any stream channel without a properly constructed crossing. Cat skidding on all areas will be timed so that excessive soil compaction does not occur as a result of excess soil moisture.

Adverse impacts of road construction may be mitigated by several means.

1. Designing the roads to minimum dimensions for the proposed use, consistent with traffic safety. If it is necessary to traverse short sections of unstable terrain, remedial measures (riprap, extra drainage, etc.) will be included in the road design.

2. Care will be exercised to protect stream channels and banks by streamside buffer strips wherever possible. In the case of roads which approach stream crossings in narrow V-shaped canyons, the right-of-way clearing width may need reduction below the road to provide a vegetative strip for stream protection. The stream crossing itself will be as narrow as possible, consistent with traffic safety. The stream channel will never be used as a disposal site for excavated material from other portions of the road; often stream crossings become unacceptably wide because of this practice.

3. Endhauling the excavated material will avoid long sidecast fills in steep terrain. Disposal sites for endhauled material will be selected with care to avoid overloading slopes and causing mass failures. Fills will be compacted where this practice will contribute to slope stability and prevent road failures.

4. Culverts and bridges will be placed in natural drainageways as near as possible in line with the flow direction to enable a direct entrance and exit for the intercepted water. Use of short, right-angle culverts will be avoided. Use of longer and skewed culverts to follow the natural drainage pattern will result in less maintenance cost even though initial installation costs will be higher. Install culverts at frequent intervals to assure that the road subgrade will remain dry and stable. Drainage from culverts will never be allowed to fall on unprotected fills. Aprons will be installed on fills under culvert outfalls. Downspouts, or other suitable conductors, will should be used to carry culvert drainage and to dissipate the kinetic energy of this water before this is allowed to run onto natural slopes.

5. Time the construction and installation of roads, bridges, and culverts so that the streamflow is optimum for completing the required work with minimum degradation of water quality. Activities will be planned so that heavy equipment spends a minimum amount of time in the stream channel. Stream banks and protective vegetation will be conserved.

6. Culvert ends and bridge abutment slopes which have received concentrated water flows will be stabilized and riprapped: In general, bridge repairs include deck, railings, expansion elements and footings, bulkheads, etc., the latter of which may require some work in the bed of a stream. Materials such as concrete, excess

grout, form oil, etc., will not be wasted in the stream. Approach fills and banks will be stabilized to prevent erosion, and trash and debris will be removed at completion of bridge site repairs.

Stabilization practices are of two general types: (1) correction of an incipient failure of a road or slope and (2) reduction of erodibility of a road fill, slope, or road cut. These practices generally have beneficial impacts since a successful stabilization activity maintains or improves water quality.

The impact of area burning on water quality can be minimized by reducing the temperature of the burn, and by reducing overland flow from the burned area to the stream channel. Burning piles instead of broadcast burning will reduce the effect of burning on water infiltration. Burning will be coordinated with weather conditions to reduce intensity of fire consistent with slash disposal objectives. Overland flows from fire lines may be reduced by waterbars or check dams along the fire line. Filter strips of undisturbed vegetation left along the bottom of the area burn will filter some of the suspended solids from overland flow. These filter strips also reduce the velocity of flow and cause deposition of sediment before it reaches the stream.

The adverse effects of scarification on water quality may be reduced by (1) keeping machinery out of stream channels, both perennial and intermittent, (2) avoiding areas where slope instability will be increased by the removal of shrubs, tree stumps, and roots; (3) avoiding the disruption of the normal distribution of water downslope; and (4) scarifying along contours. Care will be taken to leave enough small plants and plant debris to protect the soil from raindrop impact. Areas of thin soils which can be easily stripped from underlying bedrock will be avoided. Soils which have a high potential for compaction by heavy equipment even during the dry season will be excluded from scarification activities. Coarser textured soils will have scarification planned for seasons when the soil moisture is low enough to reduce soil compaction.

The impact of fire line construction on water quality can be reduced by creating as little surface disturbance as possible during construction, and by erosion control measures applied after the fire is controlled. Some guidelines are:

1. Avoid building fire trail if control can be achieved by direct attack. A slow-moving ground fire can often be suppressed by hand tools.

2. Lines will be built to a width no more than adequate to contain the fire, plus a realistic safety margin. If manpower is adequate and hand tools will do the job, lines will be built by hand rather than by machines.

3. Where possible, construct fire trails without exposing mineral soil (slash corridors).

4. Erosion control measures will be applied where necessary to prevent surface runoff from carrying sediment and debris into natural waters. Waterbars and check dams will be installed in fire trails to divert surface runoff and to reduce its velocity.

5. The burned area will be revegetated with suitable plant species as soon as possible after the fire is out.

These considerations are particularly critical in those fragile areas typified by decomposed granitic soils such as in the Elk Creek drainage.

Insect control programs using chemicals must be well planned to avoid spraying in or adjacent to streams. Use of helicopters rather than fixed wing aircraft increases the accuracy of spraying. Careful monitoring of wind and spray drift is necessary. Chemicals will only be used as a last resort and after careful testing for adverse effects.

Mitigation of long term adverse impacts resulting from timber harvest practices is primarily a matter of insuring that the cutting practice used is one that would result in environmental conditions favorable to tree regeneration on the specific sites.

Proper layout of clearcut and seed tree units will mitigate most windthrow risk.

Windthrow is negligible in shelterwood cutting areas. The three-stage cutting process reduces velocity of wind currents, and wind firmness in leave trees also results after the first cutting cycle.

Proper selection of trees to be cut in shelterwood harvesting would improve the residual trees and, therefore, improve the genetic composition of the regenerated stand. Foresters must keep the principles of applied genetics in mind when selecting trees for removal. This generally means improving quality while maintaining diversity. Although a successional stage preceding climax may be the management objective, proper practices would retain site productivity and the potential for plant succession to progress to a climax condition.

Adverse short term impacts resulting from destruction of vegetation by yarding systems will be mitigated by using only those methods that result in minimum disturbance to understory, shrub and herbaceous layers, e.g., mobile yarder, jammer, and horse yarding. However, mitigation of long term adverse impacts of various logging methods is, like development and cutting practices, a matter of insuring that resulting environmental conditions are favorable to tree regeneration on the specific sites.

In general, impacts caused by road construction can be mitigated by locating and engineering roads so as to avoid sidecasting where possible.

Specific recommendations for mitigating adverse impacts on land are also applicable to mitigation of adverse impacts on vegetation.

Mitigating of adverse short term impacts as a result of forest development treatments that destroy existing vegetation may be achieved by confining practices to small areas of land, e.g., scarification in strips or patches, mechanical furrowing or trenching, spot burning, and hand clearing and cleaning. Long term impacts associated with forest development actions such as scarification and area burning will be mitigated by insuring that such actions result in environmental conditions favorable to tree regeneration of the specific site. This requires (1) an accurate appraisal of environmental conditions on the site prior to the action (this requirement may be met by classifying forest land according to habitat types), (2) applying forest development actions to those habitat types that will respond to treatment, and (3) insuring that both considerations are incorporated into compartment development plans.

Mitigation is possible by limiting scarification and area burning to cool-moist sites, especially those on gentle slopes with deep, loam soils. The adverse genetic impact of tree improvement programs can be avoided by adhering to statistical and genetic guidelines relative to number of trees selected per breeding unit for breeding purposes. Monoculture can be mitigated by planting several species. Long term adverse impacts from fire can be mitigated by planting or seeding tree species soon after the fire. Short term adverse impacts can be mitigated by seeding a variety of herbaceous plant species soon after the fire.

Disturbed areas will be artificially revegetated when natural regeneration cannot be reasonably expected in a short period of time. Most of the practices associated with protection, i.e., insect, disease, and fire control, are in themselves mitigative since they are primarily aimed at maintaining the health and vigor of the vegetal components of the forest.

To avoid adverse impacts to the greatest number of wildlife, clear-cuts and seed tree cuts will be designed to produce the optimum "edge" effect. To avoid the short term impact of harvesting on nesting and wintering wildlife, falling, bucking, and yarding operations will be done at times other than the nesting season or months of severe winter weather, if deemed necessary by wildlife biologists. Impact on elk is a major consideration in the unit. Full use of the results of ongoing inter-agency elk-logging research will mitigate most of these impacts.

Areas denuded of vegetation as a result of tractor or other ground systems can be seeded to grass-legume-browse species best suited to a variety of wildlife.

Adverse impacts of transporation on terrestrial wildlife will be mitigated by:

1. Avoiding road construction during the nesting season.
2. Avoiding big game winter range or closing roads to travel during winter.
3. Closing spur roads or areas to vehicle traffic when not necessary for timber management.
4. Leaving vegetal screening cover along main roads through cutting areas.
5. Locating and engineering roads to avoid sidecasting soil, rocks, debris, etc., down steep sideslopes.
6. Designing cut banks along steep sideslopes to allow unrestricted wildlife travel.
7. Locating roads where they will have the least adverse impact on high use wildlife areas.

Mitigating adverse impacts on fish and other aquatic organisms will be accomplished by:

1. Insuring all roads are placed well away from the stream course to avoid siltation from fills, ditches, and road surface.
2. Maintain adequate streamside buffer zones as a thermal regulator and streamside filter.
3. Allow no skidding of timber through either live or intermittent channels.
4. Allow no channel alterations, or removal of stream gravels from either live or intermittent streams.
5. Insure that all culverts are of adequate size to handle maximum spring runoffs, are set at a low gradient, and free fall at end of culvert does not exceed one foot. Where practical, consider the installation of bridges.
6. Removal of all slash that might inadvertently fall in a stream channel.
7. Determine, prior to timber sales, the expected water yield increases and channel stability and if the particular stream can handle the anticipated impacts.
8. Slash burning should be done well away from live or intermittent streams.

Loss of habitat, if any, due to shortening the growth cycle through tree improvement, will be compensated for by the proper spacing of cuttings, size of cuttings, and timing of cuts to assure a diversity of regenerative age classes and stand densities.

Surface cover destruction will be restricted to small areas to mitigate adverse impacts of scarification, hand clearing and cleaning, mechanical brush cutting, trench furrowing, and area burning. Brush removal and thinning of security areas should be avoided on big game winter ranges, calving and fawning sites.

Mitigation of adverse impacts from snag felling can be achieved by reserving high quality snags (with regard to wildlife use) in selected

locations. Eagle and osprey nest tree preservation sites will also include adjacent dead trees and snags used for perching by both young and adults. If important snags or dead trees cannot be saved, the girdling of some live trees on the site for future wildlife use can be used as a mitigating measure. These trees will be tagged to prevent cutting by firewood cutters, etc.

Adverse impacts of thinning will be mitigated by confining the actions to the time of year when human activity on the site will not preclude reproduction or wintering activities. Treatment of slash may be needed to meet the requirements of big game.

Before any control of insects and disease is begun, a survey of the area will be conducted to determine what non-target species are present, and how they would be affected by the proposed control methods.

All requirements of the Endangered Species Act with regard to inventory and protection of critical habitat will be adhered to. This particularly applies to raptors throughout the unit and grizzly bear in this portion of Lewis and Clark County north of Highway 200 and in the Marcum Mountain area.

The mitigative measures individually described for each component of the environment in this section represent, collectively, the actions which might be taken to maintain stable ecological relationships. Consequently, they are not restated in this part.

Many practices identified as part of the program are in themselves mitigative in preventing or restoring any ecological imbalances or damage incurred in the course of carrying out disruptive practices. These mitigative measures include such practices as seeding, planting, chipping, fencing, mulching, protection, etc. Usually, the disruptive practices are those associated with the cutting, yarding, and transportation phases of the program.

The effectiveness of mitigative measures generally would be most critical in preserving the natural balance in fragile areas of low productivity, and in aquatic ecosystems.

The effects of timber management on nutrient cycling are minimal when practices are applied properly. Nutrient losses occurring immediately after logging seldom extend beyond a year or two. Nutrients lost (calcium, nitrogen, etc.) are in abundant supply in forest ecosystems. Along with weathering of parent material and return with precipitation, a loss in productivity due to nutrient deficiencies is rare in Northern Rocky Mountain ecosystems.

AESTHETICS

A primary mitigating influence is the Bureau Planning System, whereby areas of outstanding scenic quality or human interest value are identified and excluded from the timber management program or receive modified management to preserve these values.

Visual impacts will be reduced by several measures. The appearance of smoke in the atmosphere from area and spot burning of slash will be minimized by smoke management technology. This involves the coordinated effort of meteorologists and public and private forestry agencies to integrate burning schedules with weather reports so as to produce rapid fuel combustion and quick dispersal of smoke into the upper atmosphere. Alternative slash disposal measures which create no smoke may be feasible, e.g., chipping or burying of slash.

Atmospheric dust from road construction operations may be somewhat reduced by watering or subgrades during blading and surfacing operations. Dust from log hauling by truck can be abated by oiling roads. Periodic application of water or other dust pallatives to dirt or gravel surfaced roads also reduces the problem.

The visual impact of cutting practices and logging operations will be mitigated by various means. Shelterwood cutting has much less impact than clearcutting. Particularly in sensitive areas, use of continuous canopy cutting methods is required. One concept employs a system of modified shelterwood cutting which defers final removal of the forest overstory (dominant trees) until understory regeneration is large enough to present a forest-like appearance.

Clear, cool streams of high water quality are scattered through the district. The visual impact of turbid, muddy, or debris-filled streams creates a feeling of disgust to the viewer. All operations will be designed to to protect the water quality and stay within State standards of turbidity.

The adverse psychological effects created by highly visible timber management activities can be greatly reduced by skillful, perceptive use of landscape management techniques.

Landscape management techniques have various applications. On gentle terrain, a roadside buffer strip of uncut trees and undisturbed ground cover may be reserved to screen aesthetically unpleasant activity in foreground distance and middle ground distance zones from the view of sightseers.

Where clearcut areas will be visible in middle ground distance and background distance zones, negative effects will be mitigated by avoiding straight cutting edges and square or rectangular shapes, by locating cutting lines along contours so as to conform with topography, by blending cutting lines into natural vegetative features, by keeping middle ground clearcuts small, etc. The BLM's visual resource management system can also do much to reduce the unsightliness of scars on the landscape and unnatural openings created by timber management practices. The visual contrast rating will help to mitigate the visual impacts by determining which design element (form, line, color, and texture) is contributing to the greatest amount of visual contrast. Thus, by reducing the degree of contrast for any element, the overall contrast can also be reduced.

Probably a good deal of unfavorable public reaction to the aesthetic impacts of timber management exists because some people do not understand natural processes. If they can learn, for example, that the visual impact of a recent clearcutting is relatively temporary for that area because the managed forest is self-renewing, much ill feeling might be dispelled. The various news media offer some opportunities in this regard. So do outdoor classrooms for children of school age.

The high noise level produced by the engines of logging and construction equipment could probably be reduced by improved muffler systems, but so far as is known, there has been no effort in this direction.

PREHISTORIC AND HISTORIC FEATURES

Known areas with these values have been identified in the land-use planning process and other inventories and will not be affected. In addition, recent legislation requires prior evaluation for archaeological values of all specific areas to be disturbed, including roads and cutting areas. This type of inventory should avoid destruction of most sites. Timber sale contracts now require notification to BLM of sites found during any operations. When sites are found, the process for evaluation and disposition of materials is well established.

Timber management practices will be prohibited in areas surrounding sites, and access will be restricted.

Timber management activities in the vicinity of historical sites will be planned and conducted to avoid both physical and visual damage. Roads will detour around or away from them. Compartment development planning will identify these sites and provide for necessary protection in coordination with State and Federal agencies.

If harvest levels can be uniform from year to year, they will be a stabilizing influence on the timber industry, particularly to smaller mills and logging operators in outlying communities in the SYU that depend on BLM sales. Occasional increased or decreased sales may be necessary to offset shortages or depressed markets. This ability is limited by the harvest volume proposed. Over a 10-year period, the volume cannot be changed unless land use plans or other inputs to the plan change.

Ill effects on inhabitants caused by smoke from slash burning will be mitigated by burning on days when atmospheric conditions favor rapid rise and dispersal of smoke. All such burning will be done in accordance with a smoke management plan. Quarrying activities will not take place where inhabitants will be subjected to clouds of dust.

Safety hazards associated with log trucks and the motoring public will be mitigated by proper road design, avoidance of blind curves, providing adequate turnouts for passing, warning signs, and use of dust pallatives.

Accidents and injuries involving timber harvesting and mangement activities can be reduced by ensuring the employees receive adequate safety training, that they are thoroughly trained in their jobs, that they wear required safety equipment, and that they use the proper equipment, maintained in a good state of repair.

The objections of prospectors and mining claimants to timber management practices can sometimes be overcome by personal contact. Good communication with livestock producers can do much to alleviate conflicts between timber production and grazing. In most cases, timber management objectives can be met with deferment of grazing for seedling establishment rather than long-term withdrawal of an area from grazing.

Compartment plans and individual sales must be subject to public review. Involvement by special interest groups is particularly important for specific areas. This process allows feelings and facts on specific areas to be included in timber management activities that would not be expressed when a unit-wide, 10-year program is discussed.

Developed and potential recreation sites are excluded from commercial timber production and screened by permanent vegetative buffer strips, with trees reserved from cutting. Sometimes removal of danger trees may be necessary for user safety; however, logging on recreation sites and adjacent areas will be conducted during the period of least use, to the extent feasible. Sources of potable water supplying recreation sites should be permanently protected from possible contamination by any timber management practices. Roads providing access to recreation sites should be dust-proofed and built to standards that permit both car and truck traffic to move safely.

Periodic updating of land use plans will identify and resolve land use conflicts as private lands adjoining BLM commerical forest lands are developed. Timber management activities can be made more compatible by adjusting the timing and intensity.

Careful selection of cutting practices, road layout, and cutting areas can greatly reduce impacts on adjoining land. Better land use planning on private land will reduce the impact of development and logging on national resource lands.

This factor must be fully evaluated in considering the impacts of individual sales to be made in carrying out the timber management plan.

Periodic reconsideration of land use planning resource allocation is necessary. Habitat typing in developing practices for individual sites must be done to assure continued productivity. All compartment plans include habitat typing and evaluation of site potential in each stand. Fragile areas and other specific problem areas are also identified in the compartment plan.

CHAPTER 5

RESIDUAL ADVERSE IMPACTS

This section discusses the adverse impacts which can be expected to remain after a reasonable effort has been exerted to apply all applicable, feasible mitigation measures described in the previous sections. It comprises a compilation of unavoidable impacts not subject to mitigation and the residual adverse effects likely to remain despite mitigation efforts.

This analysis is necessarily subjective to a degree. A judgement factor must be imposed to estimate the effectiveness of mitigation measures based on assumed thoroughness of execution and probability of favorable technical results. It has been assumed that prescribed mitigative procedures will be used and enforced, and furthermore, that the contractor or private operator will be cooperative.

Cutting practices can have some unavoidable adverse impacts on local climates. It may be necessary to clearcut insect-infested timber on a severe site, and to burn the slash to forestall an epidemic. The resulting exposure may create microclimatic conditions which make regeneration of the site very difficult. Deviation of the general climate from its normal pattern for a year or two after cutting may cause microclimatic changes which inhibit regeneration and favor the invasion of the site by brush.

Short term air pollution by engine emissions and dust during logging operations is unavoidable but relatively insignificant.

The unavoidable adverse impacts of road construction and log hauling on local climate are relatively minor. Air quality will be temporarily degraded by engine emissions and dust in the vicinity of road construction operations and along logging roads. Micro-climates will be permanently modified in limited areas on road rights-of-way.

Despite improved smoke management technology, there will continue to be occasions when smoke from burning forest fuels will find its way into the lower atmosphere over population centers. These occurrences will be significant only as a temporary nuisance. Inevitably, there will be misapplications of prescribed fire due to human error and accidents of nature.

Some erosion and/or soil compaction will occur during cutting, yarding, and road building operation, particularly on steep terrain. Landslides and gravitational erosion cannot be completely eliminated and will periodically occur along roads as a result of freeze-thaw actions and from the water saturation of slopes during the rain and winter seasons. Severe rainstorms and spring runoff will occasionally cause blockages of drainage facilities and road washouts resulting in soil movement and loss. Accidental spills of oil, etc., will occur, but their impact can be expected to be minimal.

Development practices, such as scarification, mechanical-trenching and furrowing, area burning, spot burning and hand clearing will result in some localized erosion due to vegetal destruction. Fire line construction can be expected to result in some erosion.

WATER

Depending upon the harvest method used, the water yield from the disturbed area will temporarily increase. A temporary decrease in water quality may occur. Normal duration of these changes is two years. Removal of vegetation will cause minor changes in seasonal distributions of runoff and in the magnitude of spring runoff flows. On sites with unstable soils, higher peak-flow could conceivably initiate a cycle of stream erosion and slope failures with a decrease in water quality.

Felled trees may unavoidably slide down steep slopes and into or through streamside buffer strips, causing localized soil erosion or disturbance of the vegetation along the streambank.

Water courses near or adjacent to road construction projects can be expected to carry additional suspended sediment during construction. This sediment may be derived from excavation, embankment and bridge construction, culvert installation, and surface runoff from road and fill surfaces. Subsequently, culverts, slopes, and surfaces may fail from water saturation, heavy loading, or blockage by debris following heavy rains or spring runoff. Runoff will bypass regular channels and carry sediment to the streams.

Heavy rains immediately after a prescribed burn, before any or all rehabilitation measures can be accomplished or can take effect, may cause suspended sediment to be carried into streams even through a buffer strip. Heavy rains may also cause an increase in slope instability with a large debris avalanche or soil slump resulting. In such events, buffer strips may not prevent masses of debris and soil from reaching a stream.

Residual impacts of chemicals used for protection activities would be from accidents during application.

The construction of a fire line around an escaped slash burn may require quick control and may not allow time for thorough planning and best location of fire lines. The same urgency may dictate that fire trails be built by heavy equipment, with resulting degradation of water quality.

Significant short term adverse impacts like the removal or existing vegetation will frequently be accepted as a cost of avoiding adverse long-term impacts (i.e., excessive reforestation time lag). The best example of this occurs through the practice of mechanical slash piling and burning. The prime objective is to prepare the site for regeneration (either natural or artificial) by removing enough of the established vegetation to allow more desirable vegetation (trees) to become established.

Desired results from silvicultural treatments may not occur "on schedule" or may not work at all. For example, seed trees may not produce enough seed to stock a cutting area or a freak wind storm may break off or wind throw seed trees. Sites so damaged are not lost, so to speak, but if a forest stand is to be established on such sites within a five year time frame, the stand will have to be established artificially. Pre-commercial thinnings may be damaged by heavy snows.

ANIMALS

The implementation of mitigation measures will not entirely avoid adverse impacts on wildlife. Some effects are negative, particularly on winter range in terms of security loss, obstacles to travel, etc. Individual animals, for example, will be killed or displaced by timber management activities such as scarification, area burning, falling and bucking, yarding and road construction. Mainline roads can cause a long term impact; the presence of people at various times of the year will force a change in animal patterns of use.

Vegetative changes resulting from timber management activities may premanently affect habitat and animal populations or distribution. A scarcity of over-mature trees will affect some animal and bird species. Reproductive rates may be affected adversely.

Most practices will alter the appearance of the ecosystem and temporarily disrupt the balanced relationships between its components, particularly those practices that involve soil movement and vegetal destruction. The nutrient cycle, hydrologic cycle, and energy flows will be interrupted or altered until the impacted areas are revegetated and the ground stabilized. Fragile ecosystems, where productivity is low and the natural balance delicate, will be most severely impacted and slowest to recover, particularly where the ecological equilibrium has already been impaired by prior human activity. In the areas occupied by mainline roads, ecosystem relationships will never be restored during the life of the facility.

Almost any action of man that affects the biotic community and/or the physical environment will impact the ecosystem to some degree regardless of the mitigative measures that are brought to bear. However, with the proper application of timber management practices, the impact should be minimal in terms of the basic processes of the ecosystem and of relatively short duration, normally two to five years.

A beneficial effect of the proposed action is that it will aid in controlling the biomass buildup caused by a natural imbalance between production and decomposition on ecosystems in the region. The only other method of correcting this imbalance is with fire.

AESTHETICS

The timber management program will continue to cause some impairment of landscape character values, even when all feasible mitigating measures are carefully applied. Atmospheric smoke from prescribed burning will be visible at times, as will dust from logging and road construction. Clearcuts and seed tree cuts will detract from the natural appearance of the forest. So will road cuts and fills, and the occasional soil movements which will occur as results of some construction and logging operations. The smells and sounds of timber management operations will occasionally affect the moods of forest visitors in various ways. Unique geologic features of human interest can be adequately protected.

PREHISTORIC AND HISTORIC FEATURES

Occasionally archaeological sites will be uncovered and destroyed in timber operations because operators could not recognize the values. This is most likely to happen during road construction.

There should be no unavoidable impact on historical values since those of interest can be identified and the necessary precautions taken. Development of an area may increase vandalism.

The primary unavoidable impact involves workers in timber related jobs. Because of the small contribution of BLM timberlands to the economy of western Montana, economic impacts are insignificant. Despite safety programs and safety consciousness of employees, accidents that cause injury and occasionally deaths are going to happen. Accidents involving the motoring public and log trucks and other logging equipment will occur as long as simultaneous use is made of the road.

There should be no unavoidable impacts on nearby residential or commercial enterprises. An exception may occur in cases where unsuitable and incompatible land uses, such as an unplanned subdivision, encroach on a management area and, upon considered evaluation, it is determined that restriction of timber management activities in deference to the encroachment would not be in the best interests of the public.

There will always be some cases where timber management activities will impact adjoining lands, particularly where forested private land is used for residences or some recreational activities. The land use planning process resolves or compromises conflicts; it cannot always solve them.

In compromising conflicts between land uses and recognizing the diversity of individual opinion on what is good forest management, it is unlikely that everyone will get what they want and expect all the time on lands involved in the timber management plan. The BLM has demonstrated in this unit that the process from land use plans to individual compartment plans and the resulting implication of management practices allows people to understand what is being done and why.

CHAPTER 6

SHORT TERM USE VS. LONG TERM PRODUCTIVITY

The timber management program is, of course, not a short term use but a continuous use which involves different actions being applied to different parts of the forest over time. Most of the individual practices carried out on a particular area involve a short term use.

The length of the proposed action, which is considered the short term, is limited to a 10-year period from 1975 to 1985. At that time, a new inventory, new multiple-use considerations, re-evaluation of management practices, and current public involvement will produce a revised allowable cut for the next 10 years. What is being evaluated here is the effect of a 10-year proposal on productivity beyond 1985. In computing the harvest level, harvest volume and all practices were projected for a 400-year period to assure that lands could be productive at the proposed level for 400 years. The long term is considered to be that period beyond the initial 10-year proposed action time. Inventory data indicates that through most of the 400-year period, growth will exceed the cut. The initial 10-year period will see 70 million board feet cut from an initial standing volume of 585 million board feet. By the end of 400 years, standing volume is projected to be 960 million board feet.

CLIMATE AND AIR QUALITY

In general, the practices associated with the proposed action do not affect the climate or air as they relate to the long term productivity of the forest. There is no long term effect on air quality or climate.

GEOLOGY AND SOILS

While some development practices may have a short term detrimental impact on localized areas, most practices will not affect long term productivity. The area occupied by permanent roads will not be productive during the life of the facility.

Reduced productivity of areas occupied by temporary roads can be expected.

WATER

Since snowmelt forms a significant portion of the seasonal runoff, the increased snowpack which occurs following cutting, particularly clearcutting, may be a benefit by increasing water yield. Adverse impacts would include a possible decrease in water quality. Where slopes and stream channels are stable, a small increase will have no adverse effects and suspended sediment concentrations will remain relatively stable. Since the management plan calls for continuous scattered harvests throughout the SYU, this is a long term benefit. Periodic erosion along roadways resulting from seasonal rains and storms will have a minimal impact on the productivity of the aquatic ecosystem.

VEGETATION

The short term use of land for timber harvest will generally have little, if any, adverse impact on long term vegetative productivity provided the necessary mitigative measures are carried out. Vegetation is a renewable resource, capable of re-establishment after timber harvest

and forest development actions. Through natural revegetation and man controlled forest development actions, the forest resource can be maintained. Management will increase vigor of forest vegetation. Periods of declining growth and stagnation of trees will be reduced. Practices proposed will not have a significant effect on diversity of vegetation.

ANIMALS

Short term use of the land for timber harvest will not, as a rule, impair long term productivity for animals. Actions on winter range may be more lasting than in other areas. Removal of dense old-growth forests and restoration of new forests with more open conditions will enhance yields of wildlife forage in some cases. This forage may not increase wildlife populations.

ECOLOGY

The productivity of an impacted area will be reduced where permanent structures, primarily roads, are constructed, bare rock is exposed, or unstable soil conditions exist. Long term productivity of timber stands will be enhanced through removal of surplus biomass and increased cycling of nutrients.

AESTHETICS

Landscapes will be different than if timber management practices were not applied.

SOCIO-ECONOMIC CONDITIONS

With the exception of timber related employee accidents and accidents between the public and logging vehicles, there should be no long term effects on health and safety associated with the timber management program.

The timber management program may eventually cause a reduction in numbers of livestock using forest ranges. However, the impact on the national forage requirement will be insignificant.

LAND USE

Some timbered areas will lose their undeveloped atmosphere. With the cutting and road building activities, these areas will not be suitable for some uses. Long periods of time would be necessary to reverse the process. Occasionally, a management action would cause a loss of productivity on some sites due to a lack of complete knowledge about the site.

Due in part to other resource values, roughly one-third of the commercial forest land in the unit is not in the acreage base used to compute the allosable cut. While this may change in the future, it does have an impact on the productivity of the forest, particularly for forest products. About 4 million board feet per year will not be harvested from the excluded forest lands.

CHAPTER 7

IRREVERSIBLE AND IRRETRIEVABLE RESOURCE COMMITMENTS

This section is focused on the long term impacts of the timber management program from the perspective of irrevocable uses of resources due to such causes as resource extraction, massive erosion, destruction of human interest values, elimination of endangered species and their habitat, and irreversible changes in land use. The consideration of any of these consequences is based only upon residual risks after mitigating measures have been employed.

CLIMATE AND AIR QUALITY

No irreversible and irretrievable resource commitments identified.

GEOLOGY AND SOILS

Erosion induced by removal of the vegetative cover and the construction of roads produces an indeterminable amount of localized mass wasting which cannot be reversed or retrieved. When the vegetal cover is removed from an area where steep slopes occur and moisture is abundant, erosion will sustain itself. Where rock types and structure are conducive to weathering, the erosional rates will increase. Erosion tends toward an equilibrium over geologic time. However, in terms of the human life span, erosion caused by man's activities results in an imbalance.

Approximately three percent of the land area will be committed to mainline roads, which constitute a relatively irreversible use; however, the trend towards logging systems which require less roads would reduce

these percentages in the future. This percentage does not include those areas in landslides. The soil, rock, gravel, and other materials used to construct the roads and structures represent a form of depletion and a permanent commitment of resources. In a theoretical sense, however, roads could be abandoned and the areas returned to a lesser productive state if society should deem it necessary.

WATER

Watershed values of a drainage are irretrievably committed, to a degree, where bare rock has been exposed or exposures of bare rock have been enlarged by massive soil movements. Landslides can also destroy a natural stream channel, resulting in its relocation and the accompanying permanent loss of soil and other materials. In this unit, however, these commitments are unlikely.

VEGETATION

There are no known irreversible or irretrievable impacts of timber management on vegetation. Even where drastic misapplications may occur and result in extensive delays in tree regeneration, natural plant succession and technical progress can be expected to restore the site to a forest condition. Only where landslides expose rock surfaces can the forest condition be considered irretrievably lost.

ANIMALS

No irreversible or irretrievable commitment of animal populations is anticipated.

ECOLOGY

Certain components of the biotic community and physical environment, such as endangered species, would represent irretrievable losses, if annihilated as a result of some catastrophic event. However, the basic ecological processes would probably recover and continue. Occasional situations occur in which the natural balance has obviously been damaged beyond repair. One example is the exposure of bedrock by mass soil movement, where restoration of life-sustaining abiotic environment can be accomplished only by natural processes operating over a period of geologic time. The incidence of such occurrences and amount of land so affected would be minimal. The greatest risk of irretrievable impacts on the ecosystem resulting from soil erosion following the loss of vegetal cover exists in fragile areas. Much is unknown regarding ecological interrelationships; therefore, there may be irreversible impacts that are not presently recognized.

AESTHETICS

Roads, and to some extent the cutting areas, will create a permanent change in landscape character. To the extent that the resulting landscape offends a viewer, the impact is irreversible.

PREHISTORIC AND HISTORIC FEATURES

Inadvertent damage or destruction of archaeological sites would probably be irreversible and irretrievable. Provided sites were not completely destroyed, enough salvage might be possible to retain their human interest value.

Conceivably, all historic sites that are the works of man could be restored should they be destroyed. However, their values would be diminished and, in effect, the values lost irretrievably.

SOCIO-ECONOMIC CONDITIONS

Accidents among timber related employees that cause permanent injury or death are, of course, irreversible and irretrievable. This also applies to members of the public injured or killed in accidents involving log trucks or other equipment.

Timber management does not commit recreational values to irrevocable loss or degradation. However, at the time a given practice is carried out, some recreational values, e.g., solitude, may be impacted; thus representing an irretrievable loss to the individual affected.

LAND USE

There will be no irreversible and irretrievable loss of lands for residential, commerical, and industrial uses. Any loss of soil caused by timber management activities can be considered irretrievable in terms of potential agricultural development of an area. Some areas of forest range may be committed to timber production; however, this classification does not constitute an irreversible action. However, any amount of livestock production foregone, where grazing capacity is affected by timber management objectives, represents an irretrievable loss.

CHAPTER 8

ALTERNATIVES TO THE PROPOSED ACTION

There are two basic types of alternatives. The first is in terms of various volumes as opposed to the 7 million feet proposed. All impacts are generally proportional to the volume cut (roads, acres of harvest, slash disposal). Thus, the reader can assure that a harvest of 3.5 million feet would have half the impact of a 7 million foot cut. Other than this relationship, there is no other data of significance concerning various volume levels of less than 7 million feet. Levels in excess of 7 million feet have unacceptable impacts in terms of completed land use plans.

The second type of alternative concerns alternate methods of harvesting a given volume. The impacts of a broad range of alternative methods is discussed in Chapter 3. The mitigating measures in Chapter 4 reflect a selection of acceptable methods from all alternatives.

Two main alternatives have been identified. These alternatives are: (1) a program of no timber management, and (2) maintaining a timber management program based entirely on natural productivity without intensive timber management.

NO ACTION

This alternative would require the cessation of all timber management practices and harvesting activities wherever they are currently being carried out. It is assured that some of the protection practices associated with timber management in this statement, such as fire suppression and control, along with the reforestation of denuded areas and trespass control actions, will in all probability continue to be

carried out to some extent to protect and enhance non-timber values and uses. It is also assumed that some roads will continue to be built in order to make these values and uses available to the public. Consequently, their environmental impacts would continue; however, they are not repeated under this alternative.

It is important to point out that the Bureau administered lands are intermingled with private or other publicly managed forests, often as small isolated blocks or in a checkerboard pattern of squares 640 acres in size or smaller. Consequently, even without a Bureau timber management program, the timber management practices carried out by adjacent private landowners or managers will continue to have an impact on the environment of the Bureau administered forests insofar as road building and log hauling across the public lands and other activities are concerned. However, these impacts are beyond the scope of this analysis.

CLIMATE AND AIR QUALITY

The cessation of the prescribed burning of approximately 700 acres of logging debris each year will eliminate the temporary nuisance of the resulting smoke. In general, however, there will be little or no change in air quality under the no-program alternative.

GEOLOGY AND SOILS

Soils will be stable as a result of little surface disturbance, and erosion will be limited to localized areas where natural slides or slumps occur. Soil compaction will be localized to relatively small areas subjected to intensive human use. Any road construction for the purpose of providing public access or means for transporting private timber will continue to represent the major impact on soil stability.

WATER

The closed forest canopies will reduce water yields, particularly from snow zones and watersheds where spring rainfall constitutes a significant portion of total annual precipitation. Flood and other runoff peak levels will generally be reduced. Water quality would be the highest naturally obtainable; however, the eutrophication of inland waters would continue as a result of natural soil erosion. Water temperatures would also be generally the lowest obtainable under natural conditions.

VEGETATION

This alternative will result in the preservation or creation, over time, of forests comprised primarily of overmature stands of trees. Current timber management objectives call for the harvest of crop trees when reaching 120 years of age. No timber cutting would result in many trees reaching ages of 300 to 500 years and older, at which time natural mortality would occur and regeneration would begin. The pathological, or natural rotation, would result in a significant reduction in the growth of wood. For example, an acre of trees harvested over five successive rotations of 100 years each will grow two to three times as much wood as found on an acre of 500-year old trees. There will be a long-term trend towards climax types of vegetation which represents the mature or final stage in succession. This evolution will eventually produce, on some sites, vegetative types far different than now exist. Generally, climax vegetation is more tolerant and stable, and their canopies will eliminate considerable vegetation from the forest floor due to competition for sunlight, moisture, and nutrients.

ANIMALS

The elimination of thinning and harvesting practices may have an adverse impact on those wildlife species which require low vegetation as a source of food or habitat. On the other hand, old growth forests will support greater populations of small birds, squirrels, insects, and other organisms that inhabit the high foliage canopy or the soil. The existence of snags and deadtop trees will improve the habitat for such wildlife as eagles, hawks, owls, and woodpeckers by serving as nesting and perching sites. Food sources may be less plentiful than in the managed forest. Furthermore, the undisturbed forest will provide more suitable habitat for species which are particularly sensitive to human activities. Generally, however, the more uniform canopy cover of the undisturbed forest, having less "edge" between different vegetative types of canopies, would tend to produce a lesser variety of both flora and fauna than a forest under timber management.

In general, high water quality will be maintained with resulting benefits to aquatic wildlife. Due to reduced surface runoff, stream sedimentation will be generally limited to natural eutrophication, thereby helping to stabilize the habitat of fish and aquatic organisms. However, stream debris, in the form of windthrown timber, will increase and in some instances will result in inaccessible barriers to fish movement.

ECOLOGY

The basic ecological processes involving the nutrient and hydrologic cycles and energy flow will be relatively undisturbed. However, natural forces and human activities will continue to influence various components of the ecosystem. The characteristics of its basic living

component, vegetation, will change over time following a cyclic successional pattern. Along with it, the populations and species makeup of forest life will change as the vegetation changes in terms of species and their stages of maturity. Individual and groups of dead trees will be common. Their deterioration, along with windthrown trees, will result in a large amount of debris on the forest floor. This, in conjunction with general stand decadence, will increase the susceptibility of the forest to fires, insect infestations, and disease with attendant control measures hampered in unroaded areas.

AESTHETICS

Areas recently harvested could be reforested within 5 years, and the succeeding growth of the trees in the next 15 to 20 years would erase most of the undesirable characteristics associated with clearcut areas. The natural succession of plant and tree species will take place over time, and the preponderance of over mature or old growth stands will be generally pleasing to most forest viewers. Reduced road construction along with the elimination of the smell, sound, dust, and smoke of other operations will contribute further to the "natural" appearance or mood conveyed to forest visitors. Some roads will be constructed by other forest owners.

The increased presence of lightning prone flammable dead trees or snags resulting from natural mortality and insect and disease infestation in conjunction with the reduced access resulting from less road construction, will increase the risk of naturally caused fires and man's ability to control them, respectively. This will be offset in part by the elimination of fires stemming from timber management practices. Nonetheless, the increased incidence of wildfires will significantly impact aesthetic as well as other values. The increase in unharvested dead trees due to natural mortality and insect and disease infestations will also affect aesthetic values.

The local socio-economic consequences of this alternative would affect smaller mills and logging operators in outlying communities in the SYU. Approximately 56 primary timber related jobs and 100 secondary jobs (retail trade, service, etc.) would be lost. While some opportunities for geographic relocation and other sources of employment may be available, it can be expected that mostly unemployment with its attendant social and economic hardships to individuals and smaller communities would result. This will be slightly offset by the accompanying reduction in industrial accidents and their corresponding social and economic costs.

The revenue foregone to the U.S. Treasury and applicable local governments from the sale of timber will total about $420,000 annually.

The socio-economic impacts of a no-timber management program could, conceivably, be offset in part by any gains in non-timber related forest uses and values, such as increased recreational use. These could stimulate or increase corresponding forms of economic activity; however, the net effect could be expected to be a decrease in employment and gross national product.

The relatively high quality of undisturbed streams will appeal to fishermen and swimmers so long as accessibility and fish habitat are unimpeded. Conversely, there will be fewer recreational opportunities for hunters, since the population of predominant game species such as deer and elk may be decreased due to reduced food supplies on seral winter ranges. The reduction in the diversity of animals due to the elimination of the "edge effect" created by cutting practices will adversely affect some naturalists and birdwatchers. On the other hand, opportunities will be available to observe relatively unique species or habitat associated with unharvested forests. Reduced road construction

will prevent vehicular access to many areas, thereby minimizing or precluding some recreational uses and the development of facilities such as campgrounds and picnic areas. In other cases, reduced road construction will encourage hunting use in areas not disturbed by logging or road construction activities.

Many of the recreational related environmental impacts are offsetting as far as the various public user groups are concerned. However, this alternative will probably be most favorable to those segments of the public who enjoy the non-commodity values or non-intensive uses of the forest such as hikers, naturalists, and wilderness seekers.

Finally, the impact of this alternative as it relates to the legal requirements for the multiple-use management of the public lands would require exploration and, if necessary, the applicable laws changed.

TIMBER PROGRAM BASED ON NATURAL PRODUCTIVITY

In this alternative, timber growth, and consequently timber yield, is regulated by the forest's natural ability to reproduce itself following harvest without any cultural or artificial treatment by man. This alternative would have a decadal sustainable harvest level of 66 MMBF in the Missoula SYU. The impacts of this alternative would be essentially the same as described in Chapter 3, ENVIRONMENTAL IMPACTS.

The only difference between this alternative and the selected one is the application of pre-commercial and commercial thinning to the more productive stands in the unit. This is not a great difference, and these practices will be applied only where a positive return on costs is indicated.

CHAPTER 9

CONSULTATION AND COORDINATION

Although this document has been produced "in house", it should be noted that the exposure of a timber sale plan to the public is a continuous process rather than a point-in-time occurrence. Major points of public interaction are as follows:

1. The District Land Use Plans, which set the constraints under which the timber sale plan is carried out, undergo a systematic exposure for public input during their development and are updated when necessary. The plans covering this unit meet this standard.

2. An Annual Timber Sale Plan is developed for the unit. It is sent to all parties with an interest in our program including individuals, public interest groups, conservation-oriented organizations, units of local government, and other quasi-public groups, as well as representation of the timber industry.

3. Detailed information on any of the tracts listed in the sale plan is available to anyone upon request at the district office.

4. At the State Office level, copies of all the individual district annual timber sale plans are sent to the state clearinghouse where they undergo review to determine how well they mesh with plans of other government agencies and planning entities.

CHAPTER 10

INTENSITY OF PUBLIC INTEREST

Because of the local timber based economy and a general interest in the environment, there is a continuing interest in our timber management program by both the local people and government, plus various interest groups on the national level. However, their interests are not concerned generally with whether or not an intensive management program should be maintained or with what management practices are used, but rather are concerned with the continuing quality of the overall management job carried out by the Bureau.

Discussion of the practices involved in the proposed action has been extensive through the land use planning process in the unit. Emphasis has been placed on the types of practices and their impacts rather than the acres or volumes involved.

Based on the response to this analysis, it appears that the greatest public interest will be generated in reference to individual timber sales rather than plans of overall management practices. When a sale is in an area used by people for other purposes (hunting, etc.), they can better identify the impacts of the proposal and offer comments.

This is one reason why the timber management plan directs that individual assessments will be made for each sale as a supplement to this EAR. This could result in an EIS on a particular sale in a controversial area, although the public might not be very interested in the same management practices on a unit-wide basis.

In order to refine the analysis, a one month period was set aside for public review and comments. Availability of the draft EAR was well publicized in the media. One hundred seventy-five copies of the draft EAR were mailed to interested parties. Fifteen hours of public meetings in Missoula and Helena (five separate meetings) produced little in the way of comments. A total of three people attended. Comments were as follows:

1. Specify cutting volumes of Federal and private sources for western Montana. This was done on page 1-4.

2. Expand discussion of alternatives. This was done on page 8-1.

3. Revise Appendix to Timber Management Plan. Economic analysis is confusing. This was rewritten to state practices used and those not used because of economic analysis. Data on average site index was included to give the reader a feeling for the extent (in acres) of application of a given practice.

4. Data on jobs/million board feet is not correct. Initial data has recently been revised by Maxine Johnson to show that approximately 8 people/million board feet is the proper ratio. Changes were made on page 2-22 to reflect this data.

Eight written comments were received. Action taken on each are as follows:

LETTER #1

University of Montana
Missoula, Montana 59801
(406) 243-0211

Carling I. Malouf, Chairman
Dept of Anthropology
June 4, 1976

John Fields,
Bureau of Land Management
District Office
P.O. Box 4427
Missoula, Montana 59801

Dear Sir,

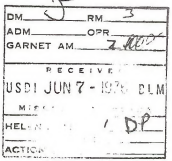
We thank you for the copy of "Environmental Analysis," which we recently received. I personally was glad, moreover, to see an old friend, and former student (too many years ago) Leo Rhein involved.

Your points of care, emphasized in the archaeology section and historic section, were appreciated. As professionals keenly aware of the rapid, and very permanent destruction of our heritage remains we compliment you and your staff for your awareness of the problem.

Sincerely yours,

Carling I Malouf

CARLING I MALOUF, PhD
Dept of Anthropology



Comment on Trimble-EAR

Letter #1.

Dr. Carling I. Malouf, University of Montana, Department of Anthropology, Missoula, Montana

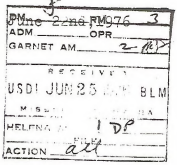
Comment

Mitigating measures are adequate for archaeological and historic resources.

Response

Some additional material has been included concerning these values.

LETTER #2



Mr. John Fields, District Manager
Missoula BLM District
P.O. Box 4427
Missoula, Mt. 59801

Dear Mr. Fields,

I have reviewed the draft EAR and the TIMBER MANAGEMENT PLAN, MISSOULA SUSTAINED YIELD UNIT and would like to make the following comments and recommendations for the record.

The EAR is so general and so broad that it could, literally, be talking about any of the BLM areas in Montana. In other words, the same text, with its principles and policies could apply to other management units and does not really address itself to the special problems and circumstances existing on this particular planning unit.

Problems you do have. One need only glance at the area map to see the scattered intermingled ownership of land areas, to know immediately that a tremendous problem exists with setting up coordinating management plans with the other land managers and owners. (I realize that this situation is not unique with the Missoula District.)

Yet this intermingling ownership is almost completely ignored in the EAR even though this has to be the most difficult factor to reckon with in land planning of this unit.

No discussion is included in the EAR of the desirability or undesirability or difficulty or possible land exchanges and consolidation; no mention is made of the difficulty of erosion control on the intermingling areas arising from the different scheduling of cutting. Whole drainages could be cut in a short time if there isn't coordinating of harvest programs. No specific details are given on the proposed wildlife and wildlife habitat management in view of the varied ownerships; no overall recreation program is presented, indeed, recreation is more like a use that doesn't exist. There is no attempt to show how the proposed "timber plan" will coordinate with the other resources in the unit. The plan, while claiming to be subject to the principles of multiple-use, fails to follow through.

The two alternatives presented in Chapter # 8 are no alternatives at all. Alternative one, "No action," can not be considered a viable one as the stated objective for this planning unit is "..to produce a high level of wood products subject to the principles of multiple use, sustained yield, and environmental quality and protection."

The second alternative cited, "maintaining a timber management program based entirely on natural production lands," would be in violation of the guidelines contained in the forestry program activity policy statement (BLM Manual 1603) and other directives which indicate that BLM lands in Montana are to be managed for maximum yield.

MISSOULA TIMBER SUSTAINED UNIT PLAN...cont.

with the growing demand in Montana for dispersed recreation, for wildlife habitat, since so much private land which has historically served as habitat is being developed, and the need to protect the Nation's headwaters, I cannot accept land unit planning which seems to pick out one resource and plan for it in a vacuum. This is precisely what this Plan does.

Neither the EAR nor the Plan have enough substance to them to inform the public about the environmental impacts arising from the proposed action or the alternatives which exist for managing this unit, therefore, since the purpose of an environmental impact statement is "to aid the agency's decisionmaking process and to advise other interested agencies and the public of the environmental consequences of planned federal action," I recommend that the BLM prepare an EIS for the Missoula Sustained Yield Unit.

cc: Zaidlicz

Sincerely,

Doris Milner

Doris Milner, Coordinator MWA-NRDC
Rt 1, Box 1410
Hamilton, Mt. 59840

Letter #2

Doris Milner, Coordinator, Montana Wilderness Association, National Resource Defence Council

Comment

EAR not specific.

Response

A wide spectrum of sites are present in the SYU. A site specific EAR will be prepared for each compartment development plan. This SYU plan and EAR is an intermediate step between the Bureauwide EIS on timber management and the site specific analysis. Refer to Page ii. Problems and a description of the SYU are discussed at some length in Chapter 2. This subject is covered in greater detail in the resource inventory part of our land use plans.

Comment

Discuss problem with intermingled ownership with private lands.

Response

Additional discussion of this problem was added on page 4-1.

Comment

Inadequate detail on other resources, plan not coordinated with other resource values.

Response

There is apparently some confusion between the purpose of the Timber Management Plan and the purpose of the Land Use Plan. For the SYU, land use planning was done first. This outlined all resource programs (wildlife, recreation, etc.) and indicated what limits would be placed on timber management to achieve balanced management on forested lands. Then the timber management plan outlines the program for the timber resource, based on the land use plan. The land use plan is the coordinating document. Refer to Appendix II, pages 3, 7, 14, and 29-32.

Comment

No action alternative is not viable.

Response

This is incorrect. Due to multiple use and environmental quality considerations, this alternative is selected for 44,000 acres (one-third of the commercial forest land in the Unit). If these considerations warranted, some or all of the remaining 100,000 acres would be so classified. BLM policy is that multiple use and environmental considerations come first, production of wood products comes second. Refer to Appendix II, page 9.

Comment

Alternative without intensive management not viable.

Response

The situation parallels the "no action" response. Where intensive management cannot meet the test of conforming with land use plans, practices will not be applied. Maximum yield is subject to multiple use environmental considerations and economic feasibility.

LETTER #3

6/23/76

Mr. John Fields, District Manager
Bureau of Land Management
P.O. Box 4427
Missoula, Montana 59801

Dear Mr. Fields:

As with all DEA's the length and complicity of this document is more or less beyond comprehension by lay and professional people alike.

The different so-called experts involved in land and timber management have undoubtedly felt their analysis is valid and beneficial to the final EIS and direction of land use.

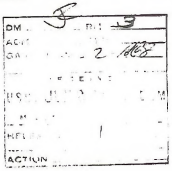
My feelings reflect more than ever the old addage "Too many cooks screw up the broth."

While both BLM and Forest Service people are so busily drawing management plans, many thousands of acres go unmanaged. Results,- millions of feet of timber dying each year. The acres being managed are under such ridiculous requirements most operators are out of the picture as far as economics go. It is a real shame that the timber operators cannot be placed on the endangered species list. Maybe the results would turn management prescriptions around.

BLM and Forest Service EIS's indicate a strong direction toward the now declining yield concept. This is of course disguised as sustained yield. Your DEA strongly indicated this and I am against this form of management. The mortality rate on public lands is high enough now.

It is not only a shame, it is a crime that this resource is not utilized to its fullest. There are many more hundreds of people that could and would be working if there was an adequate supply of timber.

I realize that public lands offer many uses to all people, and all must be considered. I also know that recreation and timber harvesting are compatable and the former comes in pretty low on the scale.



Sincerely,

Ed Livingston

Ed Livingston
Deer Lodge

10-9

LETTER #4

OPTIONAL FORM NO. 10
MAY 1962 EDITION
GSA FPMR (41 CFR) 101-11.6

UNITED STATES GOVERNMENT

Memorandum

U.S. Fish and Wildlife Service
711 Central Avenue
Billings, Montana 59101

TO : Mr. John F. Fields, District Manager
Bureau of Land Management District Office
P.O. Box 4427, Missoula, MT 59801

DATE: June 25, 1976

FROM : Area Manager, FWS, Billings, MT (ES)

SUBJECT: Timber Management Plan for the Missoula Sustained Yield Unit and Draft Environmental Analysis Record

This replies to your letter of May 28, 1976, on the subject. Our comments relate to fish and wildlife concerns and are provided to assist in your environmental assessment of the proposal and to aid in planning only.

Based on a review of the draft Environmental Analysis Record we find it well done and quite comprehensive in its coverage of environmental matters. Discussion of big-game and non-game species as related to the proposed timber management plan is quite good. However, we suggest that the section concerning impacts on aquatic life (3-21) be expanded to include potential harmful impacts to fish, including such items as effects on spawning streams from sedimentation caused by road construction and increased unseasonal stream flows because of timber cutting. A discussion of protective measures for fish should be presented in the section on "Mitigating or Enhancing Measures" similar to that which was outlined for terrestrial wildlife.

Also, the draft should address the grizzly bear, a threatened species inhabiting the Missoula Sustained Unit area. Studies are currently in progress to delineate critical habitat for this species. Should part of this unit be included as critical habitat for grizzlies, timber harvest proposals will have to be carefully scrutinized to preserve the integrity of the habitat for bears and to prevent human - bear confrontations.

We appreciate the opportunity to comment at an early stage in planning.

Burton W. Rounds

cc: Regional Director, FWS, Denver, CO (ES)

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ACTION

Buy U.S. Savings Bonds Regularly on the Payroll Savings Plan

9016-106

Letter #4

Mr. Burton W. Rounds, U.S. Fish and Wildlife Service

Comment

Expand discussion of impacts on aquatic life.

Response

This was done on page 3-20.

Comment

List protective measures for fish.

Response

This was done on page 4-16.

Comment

Address the grizzly bear.

Response

This was done on page 2-14 and 4-17.

LETTER #5

University of Montana
Missoula, Montana 59801
(406) 243-0211

June 28, 1976

John Fields
District Manager
Bureau of Land Management
District Office
P.O. Box 4427
Missoula, Montana 59801

Dear Mr. Fields:

Because of very pressing work during the past few weeks, I have been able to review the environmental analysis record for the Missoula SYU for only a short time this Sunday (June 27). Since you asked that comments be returned by June 28, I will not have time to prepare a typewritten critique. Therefore, I am returning the copy of the EAR which you sent to me with my comments pencilled in the margins. Primarily, I examined the sections dealing with wildlife.

Sincerely,

C. Les Marcum

C. Les Marcum
School of Forestry

CLM/js

Equal Opportunity in Education and Employment

Letter #5

Mr. Less Marcum, University of Montana, School of Forestry

Numerous comments on Animal portions of Chapters 2-7. Most changes clarified food relationships, winter range considerations, and other habitat requirements.

LETTER #6

GEOPLAN
2425 Mary Avenue
Missoula, MT 59801
543-5850

ADM OPR
GARNET AM
RECEIVED
USDI JUN 2 BLM
ACTION

June 28, 1976

Mr. Darrell Sall, Area Manager
Missoula District
U.S.D.I. - B.L.M.
P. O. Box 4427
Missoula, MT 59801

Dear Mr. Sall:

We have reviewed the Draft Environmental Analysis Record prepared for the Missoula Sustained Yield Unit Timber Management Plan. The Missoula District staff should be complimented on the apparent completeness of this evaluation. A few comments should be made from a geologist's viewpoint; we hope you will find these helpful:

1) In describing the environment (Chapter 2), some discussion should be given to groundwater resources, groundwater quality and potential impacts (if any) to this resource. This may be applicable in the intermountain valleys which bound the Missoula S.Y.U. where groundwater use is likely.

2) The potential for landslides and debris slide activity was mentioned several times within the draft record. Some bedrock instability problems can be factors in public safety, in contrast with small-scale mass movements which affect road maintenance costs and soil conservation. This distinction should be clarified on your "Environmental Analysis Worksheets".

3) The E.A.R. should, in some way, mention the presence and potential for construction materials and mineral commodities within or near the Missoula S.Y.U. since they must necessarily be evaluated in multiple use decisions. We recognize that this will be more closely evaluated at the compartment level.

Thank you for the opportunity to comment on this environmental analysis record.

Most sincerely,

Bruce E. Cox

Bruce E. Cox, Geologist
Land Planning Consultant

BEC:skw

Letter #6

Mr. Bruce E. Cox, Geologist, Geoplan, Missoula, Montana

Comment

More discussion of groundwater resources and impacts.

Response

Reference was made to other resource inventories with this information. On page 2-6, more emphasis was placed on surface water as receiving most of the water-oriented impacts of timber management. Impacts are discussed on page 3-12 and 3-22.

Comment

More data on mineral commodities and construction materials.

Response

Most of this data is in the resource inventory portion of our land use plans. These factors are discussed on page 3-28 and 4-22.

Page 4-4 was modified to require inventory of geologic and erosion hazards as a part of all compartment development planning.

MONTANA DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION

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ACTION

June 28, 1976

Mr. John Fields
District Manager
Bureau of Land Management
P.O. Box 4427
Missoula, MT 59801

Re: Comments on the BLM Draft Environmental Analysis Record for the Timber Management Plan of the Missoula Sustained Yield Unit

Dear Mr. Fields:

The Department of Natural Resources and Conservation would like to compliment the BLM for an excellent job in presenting and evaluating environmental considerations and planned management directions for the Missoula Unit.

We wish to comment only on several minor points. These comments related to the Executive Summary Land Use Planning Recommendations found on pages II-49 to 51, many of which, we feel are more professionally restrictive than the situations described require. For example, under subheading "a" limiting timber harvesting activities to only sanitation cutting with emphasis on maintaining aesthetic values and watershed conditions within a quarter mile of major travel routes appears unduly restrictive as selective and shelterwood cuttings can equally maintain the stated management objectives within this zone. Likewise, in subheading "c" the requirement of a minimum 150 foot wide zone on each side of main access roads for protection of watershed, maintenance of scenic quality and escape routes for big game may be unnecessary in

many situations and appears to again preclude all timber management activities. Finally, in subheading "k" limiting timber management activities within 100 feet of natural openings two (2) acres or larger, to high risk trees and requiring the leaving of all adjacent snags (presumably for wildlife considerations) may again be more restrictive than necessary and should be evaluated on the ground on a case by case basis.

We appreciate this opportunity to comment on the draft EAR and would like a copy of the final management plan when it is available.

Sincerely,

Wayne A Wetzel

WAYNE A. WETZEL
ENVIRONMENTAL COORDINATOR

WAW:bjt
cc: Andy Lukes
Gary J. Wicks

Letter #7

Mr. Wayne Wetzel, Montana Department of Natural Resources

Comment

Some guidelines from land use plans appear unduly restrictive.

Response

The guidelines are a result of professional and public input to the land use plans. Until these plans are revised, individual resource management plans are bound by them. In the case of guidline "c" (page II-29), timber cutting is not precluded. However, any cutting within such buffer zones must meet the criteria of protecting the watershed, maintaining scenic quality, and providing necessary screening for wildlife.

LETTER #8

STATE OF MONTANA

DEPARTMENT OF

FISH AND GAME

3309 Brooks Street
Missoula, Montana 59801
June 28, 1976

John Fields, District Manager
Missoula District
Bureau of Land Management
1819 Holborn
Missoula, MT 59801

Re: Draft Environmental Analysis Record
Timber Management Plan
Missoula Sustained Yield Unit

Dear John:

Enclosed are the comments prepared in the Missoula Office of the Montana Department of Fish and Game.

Yours sincerely,

Robert Rothweiler
Environmental Biologist

RR/pm
enc.

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ADM CPR
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FILE
ACTION

Comments on Draft Environmental Analysis Record,
Timber Management Plan, Missoula Sustained Yield Unit.

Water quality and quantity is a primary resource of national resource lands. Most management activities can be accomplished on these lands as long as these activities do not impair water quality standards or modify water quantity.

Forest developments, especially timber management and its associated roads have a great potential of soil erosion and reduced water quality.

Timber harvest methods may be beneficial in increasing water available for various downstream uses, however, it can also cause flooding problems downstream. An increase in water quantity increases erosion and affects stream channel stability.

A program of stream monitoring in those drainages where developmental activities are planned allows the land manager to determine changes in the quality and quantity of the stream flow. The objective of monitoring is to establish a data base whereby contractual obligations between the land manager and the land user will be met. Monitoring ultimately assures that watershed and aquatic resources for planning areas are not adversely affected.

In this regard, the natural resources lands in the Missoula Sustained Yield Unit are intermingled with lands owned by large corporations, mainly U. S. Plywood and Burlington Northern. To accomplish timber management on these type lands, the Bureau of Land Management must have cooperative management programs to protect watershed and water quality values. If these private landowners show no interest in cooperative ventures, then it is a responsibility of the Bureau of Land Management to restrict timber harvest on national resource lands to maintain stable streambanks and channel conditions.

The Department prefers to see more positive statements concerning the mitigating or enhancing measures to reduce impact of timber management of other resources on natural resource lands in the Missoula Sustained Yield Unit.

For example, the statement pertaining to WATER, page 4 - 8;

> "The adverse effects of clearcutting and seed tree cutting on water quality may be mitigated by providing streamside buffer strips of adequate width and density to reduce or eliminate sediment laden overland flow from reaching stream channels. All perennial streams and those streams which carry water during peak runoff seasons should have buffer strips. Buffer strips should contain enough trees and shrubs to provide shade for the stream and protection for the streambank. The width of the buffer strip necessary to meet these objectives should consider the slope of the ground into the stream channel; topographic shading; tree height, density, and species; stream characteristics (width, depth, and flow velocity); erodibility of the soil; groundwater levels; and precipitation patterns."

(Emphasis my own)

Example: The statement pertaining to ANIMALS, page 4 - 16;

"Adverse impacts of transportation on terrestrial wildlife may be mitigated by:

1. Avoiding road construction during the nesting season.

2. Avoiding big game winter range or closing roads to travel during winter.

3. Closing spur roads or areas to vehicle traffic when not necessary for timber management.

4. Leaving vegetal screening cover along main roads through cutting areas.

5. Locating and engineering roads to avoid sidecasting soil, rocks, debris, etc., down steep sideslopes.

6. Designing cut banks along steep sideslopes to allow unrestricted wildlife travel.

7. Locating roads where they will have the least adverse impact on high use wildlife areas."

(Emphasis my own)

These statements appear as suggestions to the land manager; written this way, he may include them in his planning or he may choose to disregard them.

We prefer to see these measures written, "all perennial streams and those streams which carry water during peak runoff seasons will have buffer strips. Buffer strips will contain enough trees and shrubs to provide shade for the stream and protection for the streambank." "Adverse impacts of transportation on terrestrial wildlife will be mitigated by..." This criticism seems trifling but mitigation and enhancing measurements are important parts of timber contracts.

The timber plan refers to various classes of animals - the Bureau of Land Management must be receptive to the requirements of all animals; however, our major concern is elk.

At one time elk ranged over most of the areas in the United States. Elk are still found in 20 states. Three Northern Rocky Mountain states -- Montana, Idaho, and Wyoming -- provide approximately 50 percent of the nation's elk taken by recreational hunting while furnishing approximately 11 percent of the nation's saw timber value.

The need for wood and wood products makes timber harvest a necessary and legitimate use of the national resource lands -- however, range located on public lands and on national forest lands determines the future of elk populations and the recreation they provide.

In Montana elk range over a variety of habitats from sparsely timbered terrain of the Missouri Breaks to the heavily timbered areas of the Continental Divide. One factor is common to all areas that support elk populations — forested land. Elk for both consumptive and nonconsumptive use represent one of the most important resources in the sustained yield unit. Therefore, they should receive primary consideration in management of the unit.

Developmental activities on forest land, specifically logging and its associated roads, have the potential to drastically modify big game habitat. Until recently, game managers and land managers assumed that these modifications were generally beneficial. Mature forest stands produced less wildlife than seral stages of forest growth resulting from disturbance such as fire or logging. Thus, they accepted timber harvest as a method to create additional forage for big game and the associated roads were utilized as a means of increasing big game harvest. Recent information, however, indicates that timber harvest may or may not benefit wildlife and additional access has not improved hunting.

In 1970 several agencies including the Montana Department of Fish and Game, the Northern Region and Intermountain Forest and Range Experiment Stations, U. S. Forest Service, the University of Montana and Missoula District, Bureau of Land Management initiated a cooperative research study to determine habitat requirements of elk, to determine elk behavior in response to logging activities, to determine the long term effects of humans on elk populations and to develop ways to effectively manage timber and maintain elk habitat. At that time, information was not adequate to resolve conflicts in resource management.

The cooperative elk-logging study is continuing, but preliminary management recommendations have been released to aid forest managers in planning for both wildlife and timber:

(1) That planning for timber sales in elk summer range include provisions for security areas immediately adjacent to the disturbed area during the active logging and/or road building period. The area provides a line-of-sight barrier and be inaccessible to motorized traffic. The ridge line between timber sale activities and the security area remain intact, with roads and logging activity below the skyline. The actual size of the security area will be determined by on-site inspection by wildlife and timber managers.

(2) In planning for location and design of transportation systems, existing elk movement patterns and probable elk crossing areas will be identified and provisions made to provide security for unimpeded movement. Where possible, several alternate routes be considered. Primary consideration will be given to: maintaining frequent dense cover areas adjacent to the road; minimizing cuts, fills and right-of-way clearings; avoiding long stretches of straight road, and providing for slash disposal along rights-of-way.

(3) That moist sites, including wet sedge meadows, bogs, seeps, etc. have been identified as a very important component of elk summer range. Preferred summer elk range exists when these moist sites are interspersed with other necessary habitat components including various timber types and densities; dry, broken and open parks, and other physical characteristics. Where these

situations exist, an area large enough to maintain the overall integrity of the habitat components be managed by protecting them from alteration. The size of the area to be managed will be determined by on-site inspection by land and wildlife mangers and other appropriate resource specialists.

(4) Wildlife managers will identify elk requirements in local areas to be used as a basic consideration on road system plans or road management decisions. Proposed road systems be evaluated for impacts on elk on an individual basis. Existing roads be evaluated to see if abandonment or closures would enhance elk management. Off-road vehicle (ORV) closures will also be considered and federal land managers assess the suitability of the new federal ORV regulation in this connection. State regulations also apply to ORV use.

(5) The elk management goal or objective will be scrutinized and clearly defined before a vehicular closure is considered. Closures may: change the relative quality of elk hunting the closured area, reduce harrassment of game animals and present some problems because of increased difficulty for hunters retrieving bagged animals.

Road closures may be good or bad depending on the elk management goal or objective for a specific hunting unit or area. Depending on terrain, existing access and patterns of cover, effects of area closures on elk management could apparently vary: from no change in hunter participation to a significant change; from no change in elk distribution to a significant change, with elk staying in an area longer and in greater numbers, and from no change in elk harvest to an increase or decrease, with a more uniform season-long harvest; hunters will usually see more elk per unit of walking effort.

Missoula, Montana
June 28, 1976

Letter #8

Mr. Robert Rothweiler, Montana Department of Fish and Game

Comment

Need for monitoring of water quality and stream flows before, during, and after logging.

Response

This was added as a requirement on page 4-8.

Comment

Recommends BLM initiative in monitoring watershed values on entire drainages, including private ownerships. If necessary to avoid unacceptable cumulative impacts, BLM should restrict timber harvest on NRL.

Response

Total monitoring was included on page 4-8. The BLM obligation to defer some actions is discussed on page 4-1.

Comment

Statements on mitigating measures are not positive enough.

Response

We crossed out about 500 should's and may's and inserted will's in Chapter 4. The measures are not suggestions, they must be included in management plans.

Comment

Major concern of Fish and Game is elk. Discussed needs of elk and use of research recommendations.

Response

On page 4-15, we state that elk are a major consideration in the Unit. We are also committed to following recommendations developed by elk-logging research.

LETTER #9

Natural Resources Defense Council, Inc.

564 HAMILTON AVENUE
PALO ALTO, CALIF. 94301

415 327-1080

Washington Office
917 15TH STREET, N.W.
WASHINGTON, D.C. 20005
202 737-5000

2345 YALE STREET
PALO ALTO, CALIF. 94306

New York Office
15 WEST 44TH STREET
NEW YORK, N.Y. 10036
212 869-0150

June 29, 1976

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HELENA AM
FILE
ACTION

Mr. Dave Pickett, Area Manager
Missoula BLM District
P. O. Box 4427
Missoula, Montana 59801

Dear Dave:

While we are not in a position to analyze the specific environmental data contained in the Bureau's draft EAR for the Missoula sustained yield unit, we have reviewed this document from the standpoint of organization, coverage and format. In our view, the EAR's most serious deficiency lies in its treatment of alternatives. We enclose herewith a letter we recently wrote to the Bureau's Division of Forestry in Washington, D.C. concerning this same problem and urge that our comments be considered in the preparation of a final EAR, and an EIS for the Missoula.

As we understand it, your office provided concerned citizens in Montana with a copy of the draft EAR and we ask that this same procedure be followed when the final EAR is issued. In particular, we request that a copy of the final EAR be sent to the following individuals:

Eldon/Liz Smith
2311 Highland Court
Bozeman, MT 59715

Ken Bohling
Box 71
Wisdom, MT 59761

Dan Block
Eastern Montana College
Dillon, MT 59725

Fred Swanson
816 Walnut
Missoula, MT 59801

Bill Cunningham
Box 12
Helena, MT 59601

Frank Culver
Dept. Nat. Resources &
Conservation
Helena, MT 59601

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Don Aldrich
410 Woodworth Ave.
Missoula, MT 59801

Jean Warren
509 Hill
Missoula, MT 59801

Doug Scott
4534 1/2 University Way, NE
Seattle, Washington 98105

Rick Applegate
Center for the Public Interest
Box 961
Bozeman, MT 59715

Randall Gloege
626 Howard Ave.
Billings, MT 59102

Tom Horobik
4000 4th Ave. N.
Great Falls, MT 59401

In addition, we ask that each of these individuals receive notification of whether the Bureau intends to prepare an EIS when that decision is made in Washington later this summer. Please let us know if there will be any difficulty in meeting these requests.

We appreciate your assistance in this matter.

Sincerely,

Ballard Jamieson, Jr.

BJ:gg

cc: Doris Milner
Gail Achterman

Enclosures

Letter #9

Mr. Ballard Jameson, Jr., Natural Resources Defense Council, Inc.

Comment

EAR needs further discussion of alternatives, and EAR/EIS should cover environmental assessment of Land Use Plans.

Response

Refer to the discussion of alternatives (expanded) in Chapter 8. A major concern in analysis is the level at which land use decisions are assessed. At the SYU level, we can discuss overall volume levels, total miles of road, gross character, and extent of practices, etc. However, it is not possible to relate these overall activities to other land uses or resource values in a specific and finite way. To do so would be an excursion into conjecture about the relative juxtaposition of various resources and land uses with the timber resource and timber uses.

This is because the timber management plan is based on forest inventory data which tells us how much timber there is in the unit, and its relative productivity, but the inventory does not tell us specifically where that timber resource is or how it relates to resources. Only compartment development plans can relate timber to other resources with sufficient specificity to make meaningful analysis possible. Therefore, the deeper discussion of alternatives and environmental assessment of other resources impacts should occur in the compartment development plan--not the land use plan or the timber management plan.

BLM land uses plans make broad areal allocations of resources and land uses, but are not detailed enough to allow a sound environmental assessment.

Land use plans were completed in the SYU during the period 1968 to 1975, immediately preceeding timber management planning. In that process, conflicts were identified between timber management practices and other resource uses. Also, adverse impacts on resource values were defined, and in many areas information was not available to fully identify significant conflicts and impacts. As a consequence, those land use plans specified removing all such lands from the timber production base for the planning period (10 years) being analyzed. This resulted in a 20 percent reduction in allowable cut (14 million board feet per decade). But even here, the areas are treated as a whole, and so is the reduction in allowable cut. No concrete information is available to relate actual volumes reduced to detailed impacts avoided for any specific area, including major drainage areas. Once again, only compartment development plans can do that.

We could, for instance, assess the various alternative impacts of adding all or part of the 44,000 acres in deferred and reserved areas to the timber production base. But, for what purpose? To do so would be a meaningless analytical exercise.

GLOSSARY

Allowable Cut - the average volume that may be harvested annually from a given forest unit which will result in the eventual attainment and perpetuation of an approximately normal distribution of age classes, normal stocking, and sustained yield.

Biome - a major biotic community, natural groups of organisms characterized by the occurrence of certain plants and animals that are dominant or influential.

Board Foot - a unit of measurement represented by a board one foot long, one foot wide, and one inch thick.

Canopy - the cover of green leaves and branches formed by the crowns of all trees in a forest.

Climax - the final stage of a succession which continues to occupy an area as long as climatic or soil conditions remain unchanged.

Commercial Forest Land - forest land which is producing, or has a site capable of producing, at least 20 cubic feet per acre per year of commercial tree species.

Compartment - a logical subdivision of a Sustained Yield Unit, usually a major drainage or watershed, generally 1,000 to 3,000 acres.

Ecology - the study of the relationship of living organisms to each other and their environment.

Forest Products - all vegetative resources grown upon or near forest lands.

Forest Rotation Age - the period of years required to establish, grow, and harvest stands of timber in order to best accomplish the definite objectives of management.

Harvest Cut - the removal of a crop or stand of financially or physically mature trees as a final cut in even aged management, or the removal of mature elements of a stand in uneven aged management.

Jammer - a log-loading machine operated either by horse or mechanical power.

Management Framework Plan (MFP) - a planning decision document which establishes, for a given area of land, land use allocations, coordination guidelines for multiple use, and objectives to be achieved for each class of land use or protection. It is the Bureau's Land Use Plan.

National Resource Lands (NRL) - tracts of land administered by the Bureau of Land Management.

Silviculture - the science and art of producing and tending a forest; the application of the knowledge of silvics in the treatment of a forest; the theory and practice of controlling forest establishment, composition, and growth.

Site - the quality of the soil, climate, and interaction of all ecological factors which determine the productive capacity of forest land.

Site Index - an expression of forest site based on the height of the dominant trees in the stand at an arbitrarily chosen age.

Timber - standing trees, down trees, or logs which are capable of being measured in board feet.

Timber Management - the application of economic factors and silvicultural principles to obtain prescribed forest management objectives.

Unit Resource Analysis - a comprehensive display of physical resource data and an analysis of the current use, production, condition, and trend of the resource and the potentials and opportunities within a planning unit, including a profile of ecological values.

APPENDIX I

ENVIRONMENTAL ANALYSIS WORKSHEET

APPENDIX I: Environmental Analysis Worksheets

--Explanation of Notations

1. A list of the discrete operations (coded 1A, 1B, etc) shown below were analyzed on the worksheets.

Practice

Intermediate Cuttings

1A Commercial Thinning
1B Sanitation-Salvage Cutting
1C Shelterwood Cutting

Final Cuttings

2A Selection Cutting
2B Shelterwood Removal Cutting
2C Seed Tree Cutting
2D Clearcutting

Ground Yarding

3A Horse Skidding
3B Tractor Skidding
3C Mobile Yarder Loaders
3D Idaho Jammers
3E Self-loading Trucks
3F Shovel
3G High-lead yarding

Road Construction

4A Clearing and Grubbing
4B Excavation
4C Embankment
4D Finishing

Road Maintenance

5A Surface Maintenance
5B Shoulder, Sideslope and Roadside Maintenance
5C Drainage Maintenance

Slash Disposal

6A Prescribed Burning
6B Mechanical Treatments
6C Isolation and Limited Treatments
6D Better Utilization

Practice

Development

7A Tree Improvement
7B Site Improvement
7C Regeneration
7D Precommercial Thinning

Fire Protection

8A Suppression
8B Prevention

Insect Control

9A Silvicultural Control
9B Physical Control

Disease Control

10A Silvicultural Control
10B Physical Control

2. Impact notations are defined as follows:

0 = No or negligible impact

L = Low Impact

M = Moderate impact

H = High Impact

+ = Positive impact

- = Negative Impact

X = Impact of unknown magnitude and sign

Remarks: _____

HARVEST

STAGES OF IMPLEMENTATION	Interim Controls	Final Controls	Ground Yarding
DISCRETE OPERATIONS			

	1A	1B	1C	2A	2B	2C	2D	3A	3B	3C	3D	3E	3F
I. NON-LIVING COMPONENTS													
A. AIR													
Air Movement Patterns	O	O	L	L	T	M	M	O	O	O	O	O	O
Temperature	L	L	L	L	L	M	M	O	O	O	O	O	O
Particulate Matter	O	O	O	O	O	O	O	O	-L	-L	-L	-L	-L
B. LAND													
Soil Depth	O	O	O	O	O	O	O	O	-L	-L	O	O	O
Soil Structure	O	O	O	O	O	O	O	-M	-M	-M	-L	-L	-L
Soil Nutrient	X	X	X	X	X	L	L	O	O	O	O	O	O
Soil Erosion	O	O	O	-L	-L	-M	-M	-M	-M	-M	-L	-L	-L
C. WATER													
Sediment Load	O	O	O	-L	-L	-M	-M	-M	-L	-M	-L	-L	-L
Dissolved Solids	O	O	O	O	O	X	X	O	O	O	O	O	O
Nutrients	X	X	X	X	X	X	X	O	O	O	O	O	O
Solid Debris	X	O	X	O	O	-L	-L	O	O	O	O	O	O
Dissolved Oxygen	O	O	O	O	O	X	X	O	O	O	O	O	O
Temperature	O	O	O	O	O	X	X	O	O	O	O	O	O
II. LIVING COMPONENTS													
A. PLANTS (AQUATIC)	O	O	O	X	V	L	L	L	L	L	L	L	L
B. PLANTS (TERRESTRIAL)													
Grasses	+L	X	L	+L	L	L	L	X	L	Y	Y	X	Y
Shrubs	+L	Y	L	+L	L	L	L	X	L	X	Y	Y	Y
Conifers	+L	X	L	+L	L	L	L	X	L	Y	Y	X	Y
Broadleaf Trees	+L	X	L	X	+L	L	L	X	L	X	X	X	Y
C. ANIMALS (AQUATIC)													
Fish	O	O	O	L	L	-L	-L	-L	-L	-L	-L	-L	O
Invertebrates	O	O	O	X	V	X	X	X	X	Y	Y	Y	Y
Zoo Plankton	O	O	O	X	X	X	X	X	X	Y	Y	Y	Y
D. ANIMALS (TERRESTRIAL)													
Mammals	Y	Y	X	Y	Y	X	X	X	X	X	Y	X	X
Birds	Y	Y	X	Y	Y	X	X	Y	X	Y	Y	Y	X
Reptiles	Y	Y	X	Y	Y	X	X	X	X	Y	Y	X	X
III. ECOLOGICAL INTERRELATIONSHIP													
A. ECOLOGICAL PROCESSES													
Succession	Y	O	M	L	L	L	L	L	M	L	L	L	L
Food Relationships	X	Y	Y	Y	Y	X	Y	X	X	X	Y	X	X
Community Relationships	X	Y	X	Y	Y	X	Y	X	X	X	Y	X	X
IV. HUMAN VALUES													
A. LANDSCAPE CHARACTER	L	O	L	L	M	H	L	O	L	L	Y	X	X
B. SOCIOCULTURAL INTERESTS	O	O	O	L	L	Y	Y	X	Y	X	Y	X	X

Remarks: _____

HARVEST (cont)

STAGES OF IMPLEMENTATION	Road Construction					Road Maintenance		
DISCRETE OPERATIONS	4A	4B	4C	4D		5A	5B	5C
I. NON-LIVING COMPONENTS								
A. AIR								
Air Movement Patterns	-O	O	O	O		O	O	O
Temperature	O	O	O	O		O	O	O
Particulate Matter	-L	-L	-L	-L		-L	O	O
B. LAND								
Soil Depth	-L	-H	-H	O		O	O	O
Soil Structure	-L	-H	-H	O		O	O	O
Soil Nutrient	X	X	X	O		O	O	O
Soil Erosion	-L	-H	-H	O		O	O	-L
C. WATER								
Sediment Load	-L	-M	-M	O		O	O	-L
Dissolved Solids	L	L	L	O		O	O	O
Nutrients	X	X	X	O		O	O	O
Solid Debris	O	O	O	O		O	O	O
Dissolved Oxygen	X	X	X	O		O	O	O
Temperature	X	X	X	O		O	O	O
II. LIVING COMPONENTS								
A. PLANTS (AQUATIC)	L	L	L	O		O	O	L
B. PLANTS (TERRESTRIAL)								
Grasses	M	-M	-M	O		O	L	O
Shrubs	H	-M	-M	O		O	L	O
Conifers	H	-M	-M	O		O	O	O
Broadleaf Trees	H	-M	-M	O		O	O	O
C. ANIMALS (AQUATIC)								
Fish	-L	-L	-L			O	O	-L
Invertebrates	X	X	X			O	O	O
Zoo Plankton	X	X	X			O	O	O
D. ANIMALS (TERRESTRIAL)								
Mammals	L	X	X			O	O	O
Birds	L	X	X			O	O	O
Reptiles	X	X	X			O	O	O
III. ECOLOGICAL INTERRELATIONSHIP								
A. ECOLOGICAL PROCESSES								
Succession	M	L	L			O	L	O
Food Relationships	M	L	L			O	X	O
Community Relationships	M	L	L			O	O	O
IV. HUMAN VALUES								
A. LANDSCAPE CHARACTER	H	M	M			O	O	A
B. SOCIOCULTURAL INTERESTS	X	X	X			O	O	A

Remarks:

SLAG - DISPOSAL

STAGES OF IMPLEMENTATION				
DISCRETE OPERATIONS	6A	6B	6C	6D
I. NON-LIVING COMPONENTS				
A. AIR				
Air Movement Patterns	O	O	O	O
Temperature	X	O	O	O
Particulate Matter	-L	-L	O	O
B. LAND				
Soil Depth	O	O	O	O
Soil Structure	O	O	O	O
Soil Nutrient	-M	X	O	-L
Soil Erosion	X	X	X	O
C. WATER				
Sediment Load	X	X	X	O
Dissolved Solids	O	O	O	O
Nutrients	X	X	O	O
Solid Debris	O	O	O	O
Dissolved Oxygen	O	O	O	O
Temperature	O	O	O	O
II. LIVING COMPONENTS				
A. PLANTS (AQUATIC)	X	Y	X	O
B. PLANTS (TERRESTRIAL)				
Grasses	-L	O	O	O
Shrubs	-M	O	O	O
Conifers	X	O	O	O
Broadleaf Trees	X	O	O	O
C. ANIMALS (AQUATIC)				
Fish	X	O	O	O
Invertebrates	X	O	O	O
Zoo Plankton	X	O	O	O
D. ANIMALS (TERRESTRIAL)				
Mammals	-L	-L	X	-L
Birds	X	X	X	X
Reptiles	Y	X	Y	Y
III. ECOLOGICAL INTERRELATIONSHIP				
A. ECOLOGICAL PROCESSES				
Succession	M	L	O	O
Food Relationships	M	L	O	O
Community Relationships	M	L	O	O
IV. HUMAN VALUES				
A. LANDSCAPE CHARACTER	L	O	O	O
B. SOCIOCULTURAL INTERESTS	X	O	O	X

Remarks: _____

DEVELOPMENT

STAGES OF IMPLEMENTATION				
DISCRETE OPERATIONS	A	B	C	D
I. NON-LIVING COMPONENTS				
A. AIR				
Air Movement Patterns	O	O	X	X
Temperature	O	L	O	X
Particulate Matter	O	L	O	O
B. LAND				
Soil Depth	O	L	O	O
Soil Structure	O	L	O	O
Soil Nutrient	O	L	O	X
Soil Erosion	O	L	L	O
C. WATER				
Sediment Load	O	X	L	O
Dissolved Solids	O	X	O	O
Nutrients	O	X	O	O
Solid Debris	O	O	O	O
Dissolved Oxygen	O	O	O	O
Temperature	O	O	O	O
II. LIVING COMPONENTS				
A. PLANTS (AQUATIC)	O	X	L	O
B. PLANTS (TERRESTRIAL)				
Grasses	O	M	L	L
Shrubs	O	M	L	L
Conifers	M	H	H	H
Broadleaf Trees	O	M	L	L
C. ANIMALS (AQUATIC)				
Fish	O	X	X	O
Invertebrates	O	X	X	O
Zoo Plankton	O	O	O	O
D. ANIMALS (TERRESTRIAL)				
Mammals	O	X	X	X
Birds	O	X	X	X
Reptiles	O	X	X	O
III. ECOLOGICAL INTERRELATIONSHIP				
A. ECOLOGICAL PROCESSES				
Succession	L	L	L	O
Food Relationships	O	X	X	X
Community Relationships	O	X	X	X
IV. HUMAN VALUES				
A. LANDSCAPE CHARACTER	O	L	L	O
B. SOCIOCULTURAL INTERESTS	L	L	L	O

Remarks: _____

PROTECTION

STAGES OF IMPLEMENTATION			Fire			Insects			Disease		
DISCRETE OPERATIONS											
I. NON-LIVING COMPONENTS	8A	8B		9A	9B		10A	10B			
A. AIR											
Air Movement Patterns	L	L		X	X		X	X			
Temperature	L	L		O	O		O	O			
Particulate Matter	+L	+L		O	O		O	O			
B. LAND											
Soil Depth	O	O		O	O		O	O			
Soil Structure	X	X		O	O		O	O			
Soil Nutrient	X	X		O	O		O	O			
Soil Erosion	+L	+L		O	O		O	O			
C. WATER											
Sediment Load	+L	+L		O	O		O	O			
Dissolved Solids	X	X		O	O		O	O			
Nutrients	X	X		O	O		O	O			
Solid Debris	+L	+L		O	O		O	O			
Dissolved Oxygen	X	X		O	O		O	O			
Temperature	+L	+L		O	O		O	O			
II. LIVING COMPONENTS											
A. PLANTS (AQUATIC)	+L	+L		O	O		O	O			
B. PLANTS (TERRESTRIAL)											
Grasses	L	L		O	O		O	O			
Shrubs	L	L		O	O		O	O			
Conifers	+L	+L		O	O		+L	+L			
Broadleaf Trees	L	L		O	O		O	O			
C. ANIMALS (AQUATIC)											
Fish	+L	+L		O	O		O	O			
Invertebrates	X	X		O	O		O	O			
Zoo Plankton	X	X		O	O		O	O			
D. ANIMALS (TERRESTRIAL)											
Mammals	X	X		X	X		X	X			
Birds	X	X		X	X		X	X			
Reptiles	X	X		X	X		X	X			
III. ECOLOGICAL INTERRELATIONSHIP											
A. ECOLOGICAL PROCESSES											
Succession	M	M		X	X		X	X			
Food Relationships	L	L		X	X		X	X			
Community Relationships	M	M		X	X		X	X			
IV. HUMAN VALUES											
A. LANDSCAPE CHARACTER	M	M		X	X		X	X			
B. SOCIOCULTURAL INTERESTS	L	L		X	X		X	X			

APPENDIX II

TIMBER MANAGEMENT PLAN
FOR THE
MISSOULA SUSTAINED YIELD UNIT

March 1976

BUREAU OF LAND MANAGEMENT
U.S. DEPARTMENT OF THE INTERIOR

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SUMMARY

The role of forests in maintaining a quality environment and meeting growing demands for many other forest uses beyond timber production are a part of awakened environmental concern. At the same time, the nation's demand for more wood products continues to increase with population and economic growth.

The National Resource Lands in the Missoula District have been designated as the Missoula Sustained Yield Unit for purposes of timber management planning. This is all the NRL in Missoula, Granite, Powell, and Lewis and Clark Counties. In this plan, it is referred to as the Missoula SYU (map in Appendix).

The primary forest production objective in the Missoula SYU is to produce a high level of wood products from forested lands classified as available for timber production subject to the principles of multiple use, sustained yield, and environmental quality and protection. Such an approach has been taken in our land use plans and our policies and procedures for timber management planning. The key to this approach lies in asking first the question of environmental feasibility, and then the question of economic feasibility in the development of forest management plans and programs.

I. PURPOSE AND SCOPE

The purpose of this report is to present the results of the application of timber management planning policies and procedures to the recently completed reinventory of the Missoula SYU. Six harvest level alternatives were run and analyzed, as shown on Table 1. Alternative #6 has been selected as the highest level of sustained timber production that can be achieved within environmental and economic constraints, and in conformance with completed land use plans.

A plan has been developed indicating the manpower, funding, and size and timing of investments needed to fully implement the program.

TABLE 1
Harvest Level Alternatives

Alternative #	Harvest Alternative	Sustainable Harvest Levels (MMBF Per Decade)
1.	Dominant Use- Timber Production (Without Intensive Management	95
2.	Dominant Use Timber Production (With Intensive Management)	110
3.	Multiple Use- Timber Management (Without Intensive Management)	75
4.	Multiple Use - Timber Management (With Intensive Management	84
5.	Multiple Use Timber Management/ Development Deferred (Without Intensive Management)	66
6.	Multiple Use Timber Management/ Development Deferred (With Intensive management)	70

Coordination with the MFP (Land Use Plan)

Portions of the planning unit land base that are suitable for commerical forest production are identified in the URA, Step 4, and in Step 1 of the MFP process, which lists the activity recommendations for full timber production. In Steps 2 and 3 of the MFP process, this activity recommendation is tempered by policy, environmental considerations, and multiple-use trade-offs. This results in a generalized zoning of the planning unit which identifies portions of the commerical forest land base which are available for intensive timber production, portions of the commercial land base on which management practices must be tempered because of environmental or multiple-use considerations, and portions of the commerical forest land base which are not available for timber production because of the same considerations. See Appendix B (Timber Management Plan) for detail on forest management guidelines and restrictions.

Findings

The basic conclusion reached is that there will be fewer acres on which timber production can be the primary objective, and that more money and effort must be spent on environmental protection and support of non-timber uses than in the past. The commerical forest land base has been reduced by 28,000 acres from the 1965 forest inventory level. At the same time, the reduced commerical forest land base has the potential for higher timber production through intensive management practices. However, the harvest level we have selected for the first decade is much lower than the higher production level of previous years. The major findings are as follows:

1. Commercial Forest Land Base

The commercial forest land base is substantially larger than the acreage available for full timber production. The commercial forest land base is 144,000 acres. Completed land use plans covering the entire unit have reduced the base as follows:

a. Forty four thousand (44,000) acres were classified as development deferred areas until a multi-resource inventory is completed and land-use plans are revised. Part or all of the deferrals may continue indefinitely, depending on other resource values requiring protection. This acreage was deducted from the base.

b. Ten thousand (10,000) acres are restricted to modified cutting to protect other resource uses and critical environmental values. These acres remain in the commercial forest land base, but yields from these acres are reduced approximately 5% due to cutting restrictions. Table 2 shows the nature of the restrictions by resource values.

TABLE 2
Deletions and Restrictions Effecting the Commercial Forest Land Base

Resource	No Cutting (Acres)	Restricted Cutting (Acres)
Recreation Areas	---	700
Streamside Corridors	---	2000 (80 miles)
Watershed Protection	---	700
Scenic Corridors	---	4800 (25 miles)
Wildlife Habitat	--	1800
"Development Deferred" areas	44,000	---
TOTAL	44,000	10,000

Figure No. 6

Mature Douglas-fir stand along main access road
Average volume/acre - 10 MBF

Figure No. 7

Same stand shown in Photo 6 following removal of
2 MBF/acre from the scenic corridor

2. Multiple Use Outputs and Environmental Protection

Approximately 80 miles of streams will be protected by buffer strips with cutting restrictions ranging from full exclusion of timber harvest to modified cutting practices. Similarly, buffer strips will be maintained along 25 miles of road to provide natural screens for wildlife approaching and crossing roads and to enhance scenic corridors (see Figures 6 and 7). Another 4,000 acres in scenic areas will be protected by some form of harvest restrictions. Protection will be given to planned recreation sites by altering cutting practices on approximately 700 acres of commerical forest land.

3. Timber Management Plan

The plan (Alternative #6) was computed on the basis of the International 1/8" log rule and provides for an undiminishing flow of 91 million board feet per decade under the full intensive management level. For operational purposes, this level was converted to the Scribner log rule, resulting in an annual cut of 70 million board feet over the next decade. This consists of 2 million board feet in commerical thinning, and 68 million board feet in final harvest volume. When compared to the 1965 declared allowable cut level of 100 million board feet per decade (Scribner), which consisted of live final harvest volume, a decrease of 30 million board feet per decade is indicated.

4. Intensive Management Input to Timber Management Planning

The full intensive management program of 70 million board feet per decade (Scribner) amounts to a 4 million board feet increase over the base non-intensive timber management level of 66 million board feet per decade. The full program level includes three intensive management practices which were not included in the base level. These practices are commerical thinning, precommerical thinning, and intensive reforestation. They were found to be environmentally and economically feasible, and their production increment is based on full implementation of these practices through sustained funding.

5. Alternative Programs and Future Flexibility

The program presented represents a full level effort. In view of national timber needs and the importance of environmental protection, no reduced effort can reasonably be proposed. After an intensive inventory of 44,000 acres in "development deferred" areas is complete and land use plans revised, it may be necessary to recompute the cut. Also, formal classification of lands for other resource protection, after public participation through the planning system, may require further adjustments in the forest land base. Timber management planning policies contain the flexibility to make such adjustments when needed. The BLM forest model computer program will permit calculations to be run on reasonably short notice.

II. INTRODUCTION

1970 marked the beginning of a decade of awakened environmental concern. Across the nation support is building for realistic efforts to halt environmental destruction and to restore damage already done. Forests are recognized as an especially valuable part of the environment to be protected. The argument that increased production of timber is needed for homes and economic health is no longer accepted without question. An unwillingness to compromise the forest environment is found in today's communities and reflected in the Congress.

At the same time, the nation's population and economic growth continues upward. The demand for wood products continues apace with it. The ability to meet this growing demand for wood from the forest resources of the nation is in some doubt. Under present levels of management intensity, timber production is projected to begin falling short of needs by 1985, with development of a significant supply gap by 2000. Stringent efforts to stem inflation have temporarily dampened demands for wood, as home construction has been hobbled by high interest rates. Pent-up housing demands will have to be met, however, and the long run supply-demand outlook for wood is unchanged.

The objectives of full forest production to meet wood needs and the managing of a forest to protect environmental values can be met with a balanced, rational approach. The key concept is to first ask the question of environmental feasibility and then the question of economic feasibility. This is the approach taken in the Missoula SYU Timber Management Plan.

For the Missoula SYU, a potential for intensive management lies in 144,000 acres of forest land in the unit. These forests also represent part of western Montana's forest lands of key importance in maintaining an environment of stable soils, clean water, productive fisheries, wildlife habitat, recreation days, and enjoyable landscape.

Even though these forest lands are capable of producing 7 MMBF annually, they are currently producing only 3.5 MMBF per year. OMB and congressional limitations on funding and manpower have held the sales offerings to the lower level. In recent years, BLM lands produced an average of 10 MMBF per year. Some intensive practices such as precommerical thinning, sanitation thinning, and reforestation are presently standard procedures. However, acres treated each year are not sufficient to maintain the recommended harvest level. Other practices, such as commerical thinning, are being pursued on a small scale test basis. Multiple-use management, providing for other forest resource uses and environmental protection, is carried out to the extent possible under current resource knowledge, technology, and funding.

This timber management plan develops new data on forest resource conditions, multiple-use, and environmental protection needs. Its findings are that there will be less acres on which timber production can be the primary objective, and that more effort and money must be devoted to the environment and non-timber uses. At the same time, it finds that the reduced commerical forest base has potential for increased timber production to offset partially that acreage and production which now must be foregone for other important uses.

Preparation of this plan had its beginning in 1970, when the Bureau of Land Management began development of a public domain timber management program that was responsive to multiple use needs, sound forest conservation, and the fullest level of timber production feasible through intensive management. The initial phase of this program was a reinventory of the public domain forest lands. The Missoula SYU was selected as a pilot area for the reinventory.

III. SCOPE

This report encompasses all the inputs entering into the computation of a Missoula SYU timber management program needed for its implementation. It compares this plan with the one now in operation. Thus, the following components are covered:

- New inventory results and methods with explanation of differences in relation to the previous inventory.
- The new potential management plan with explanation of policies and procedures used in its calculation.
- Key non-timber use values and environmental protection steps taken to implement the proposed timber management plan.
- Economic analysis used in determining levels of intensive forestry practices entering into the allowable cut computation.
- Program requirements necessary for implementation of the management plan.

Full indepth treatment of each of these components would require five separate and substantial reports. Therefore, this report employs condensed summaries of its components, giving reference to more complete treatments where needed. However, some of the economic analysis is attached as an appendix.

IV. TIMBER MANAGEMENT PLANNING POLICIES AND THEIR IMPLEMENTATION

The plan was developed in accordance with BLM policy and procedures and within the framework of the Bureau's Planning System, BLM Manual 1601-1603.

For comparative purposes, the five major planning policies and their implementation in the proposed plan are briefly described as follows:

1. Policy-Sustained Yield Level. Commercial forest land shall be managed under the principle of sustained yield. Sustained yield is defined as a policy which requires planning for a high-level and undiminishing output of wood. The sustained yield level shall include all merchantable wood material to be realized from the planned types of harvest.

   Implementation. Through the use of a computerized forest model, the recommended cutting level was computed based on a projection of the forest 400 years into the future. The coniferous wood volumes from the planned methods of harvest, in the form of commercial thinning and final harvest cutting was identified and in total provided for an undiminishing flow of wood over the 400 year projection period.

2. Policy - Size of Sustained Yield Areas. The size of the area for which an allowable cut is to be determined shall be such as to permit access to a sustained source of timber for each of

its substantial markets or its clusters of communities within which conversion facilities are sufficiently varied to utilize the forest output. The Missoula SYU meets this standard.

3. Policy - Multiple Use Considerations. The allowable cut shall relate to commercial forest land judged to be suitable and available for wood production. Forested lands managed for aesthetic, recreational, watershed, wildlife habitat, or other uses, to the exclusion of timber cutting, shall not be included in the commercial forest base. The allowable cut shall also reflect the effects of multiple use management on lands judged to be suitable and available for wood production.

   Implementation . Based on inventories and land use plans, those lands which are not available for cutting in order to assure protection and enhancement of other forest resource values and uses were identified and excluded from the timber management base. Additionally, the cut was reduced to reflect special cutting practices necessary to protect and enhance other forest resource values and uses when these practices affected wood growth and yield. The types of land use classifications which were identified and accounted for in developing the proposed timber management plan include intensive use recreational areas, scenic corridors, scenic areas, wildlife habitat, streamside corridors, critical watersheds, buffer zones, and damageable sites. (Refer to Appendix B.)

4. Policy - Planning Horizon. The determination of the allowable cut shall represent the planning of the wood production segment of the future forest management program. In making the necessary forecasts, the planners shall look far enough ahead so as to take into account on-going trends or anticipated events judged to be reasonably discernible. The planning horizon should be flexible, with short horizons in some cases and longer horizons in others. Normally, the second decade hence shall represent the period upon which future management practices shall be based.

Implementation. The commercial forest lands shall be managed on a sawlog objective in consideration of the industry's demands for wood products as forecasted for the foreseeable future. Consistent with this objective, the International 1/8" log rule was selected as a relatively accurate measure of forest productivity in order to provide for the highest sustainable level of potential lumber production. The allowable cut, computed in International 1/8" board feet, was converted to Scribner board feet for the first decade for operational purposes. In light of current trends in improved tree utilization, the minimum merchantable diameters were set at 7" DBH with a variable top in measuring lumber recovery. Cutting levels do not include volume removed in smaller products (corral rails, fence posts) or salvage of dead trees. Removal of some material of this type is occurring, but averages less than 200 MBF per year. The planning horizon of twenty years was used as a basis for

identifying intensive management practices such as precommercial and commercial thinning and rejecting such practices as forest genetics as being improbable within the planning horizon.

5. Policy - Environmental Feasibility and Economic Analysis. Silvicultural practices shall be analyzed on the basis of their environmental and economic feasibility. Furthermore, the influence of present and planned silvicultural and utilization practices on the productivity of the forest shall be reflected in the allowable cut.

Implementation. Four intensive management practices for a variety site and stand conditions were analyzed to determine their economic feasibility and relative ranking. The included intensive reforestation, precommercial thinning, commercial thinning, and stand conversion. As a result of the economic analysis, the stand conversion practice was dropped because it was not economically feasible. Fertilization was not considered at this time on the basis of its possible detrimental effects on water quality which need further investigation. Forest genetics (tree improvement) was considered but dropped at this time because this program was not expected to be a common management practice during the planning horizon. Planting is dropped except to reforest 6,000 acres of presently non-stocked sites, mostly unregenerated clearcuts. Precommercial thinning alone was not feasible.

Precommercial thinning allowed by commercial thinning and commercial thinning alone were found to be economically feasible and were included in the proposed timber management plan. While no major developments or innovations beyond the twenty year planning horizon were assumed, the practices forecast to be operational by this time were considered as on-going programs thereafter. Consequently, the effect of these practices on the future productivity of the forest, along with improved tree utilization, are reflected in the proposed plan.

V. RESOURCE OUTPUTS FOR THE PROPOSED TIMBER MANAGEMENT PLAN

The timber management plan has a great influence on the production of other forest uses and values. In turn, as discussed in the previous section, multiple use considerations affect the cut. The following table presents the new allowable cut and acres cut by harvest components.

TABLE 3
Timber Output Under the New Timber Management Plan

Harvest Distribution	Million Board Feet/Decade (Scribner)
Basic Final Harvest	66
Additional Harvest Attributable to Inventive Management	
Final Harvest	2
Commercial Thinning	2
TOTAL HARVEST	70

TABLE 4
Acres Cut Under the New Timber Management Plan

Harvest Distribution	Acres Cut/Decade	
Final Harvest		
Partial Cut	20,250	
Clearcut	1,150	
Sub Total - Final Harvest		21,400
Commercial Thinning		3,050
TOTAL ACRES		24,450

The volumes shown in Table 3 are the results of applying the proposed timber management policies described in the preceeding section to the new forest inventory completed by BLM in 1971 for the Missoula SYU.

Out of a total allowable cut level of 70 million board feet/decade, 4 million board feet or approximately 5% of the total cut is attributable to intensive management. All of the volume figures in Table 3 would have been higher if other multiple use values and environmental protection needs were ignored. They were not, however. A total of 40 million board feet/decade in annual production from commercial forest lands is foregone in order to protect and enhance other resources. (Refer to Alternatives 2 and 6 on page II-2.) Approximately 35% of this reduction is the result of our land use planning which identified 44,000 acres of commercial forest land as "development deferred" areas. (Refer to Alternative 4, page II-2.) These areas will remain in this category until we have completed a multi-resource inventory and land use plans are revised. The remainder of this reduction is attributable to practices designed to protect other resource values and uses on 100,000 acres of commercial forest land and special practices on 10,000 acres for values shown in Table 5.

Modified harvesting is prescribed for recreation areas, wildlife habitat, streamside protection corridors, scenic corridors, along roads, and special scenic areas. Table 5 gives a breakdown of these measures. Outputs in this table apply only to commercial forest lands on which harvest is reduced. Inclusion of noncommercial forest lands would significantly increase these statistics.

TABLE 5

Multiple Use - Environmental Protection
Land Use Plan Considerations

Resource	No Cutting (Acres)	Restricted Cutting (Acres)
Recreation Areas	----	700
Streamside Corridors	----	2,000 (80 miles)
Watershed Protection	----	700
Scenic Corridors	----	4,800 (25 miles)
Wildlife Habitat	----	1,800
"Development Deferred" Areas	44,000	---
TOTAL	44,000	10,000

VI. FLEXIBILITY FOR FUTURE ADJUSTMENTS

The BLM timber management planning policies and procedures call for the reinventory of forest lands and recalculations of allowable cut every ten years. Furthermore, the policies and procedures permit a recalculation of the cut at any time within each decade if any significant events warrant a recalculation. Such events could be losses through catastrophes, evidence of failures or shortcomings in practices adopted, funds or staffing insufficient to make management investments of schedule, development of new technology or research findings that permit introduction of new practices, and changes in land use classification.

Thus, a new timber management plan is not irreversible or rigid. If it should be proven too optimistic, it can be trimmed back at any time. If new information develops or better techniques are found to increase production, these can be entered into the computer program and the plan updated.

During the 1975-1985 decade, there may be several modifications to deal with. Current work in forest genetics may expand to a point where such a practice will be probably within the planning horizon. If so, this practice can be added and the cut recomputed to reflect it.

The current multiple use impact adjustments and exclusions from the allowable cut are based primarily on completed land use plans. If these plans are revised furing the decade and significant changes to occur, the cut can be recomputed as such decisions are reached.

VII. PROGRAM REQUIREMENTS FOR THE TIMBER MANAGEMENT PLAN

An analysis of the manpower and funding requirements necessary to implement the timber management plan for the Missoula SYU shows that such a plan could be initiated in FY 78 if sufficient funds and skilled people are made available to carry out all facets of this plan, especially the intensive timber management practices.

It should be noted that most of the personnel needed to carry out the program are in support type positions. Sufficient additional positions, man months, and funds are needed to do the following:

a. Additional volume and numbers of sales are additive to the increased requirements. Increased field checks on contractor performance to meet environmental requirements in contracts is essential.

b. The timber management plan is very comprehensive in that it provides for timber production reconciled with multiple use and environmental requirements. Intensive multi-resource planning and administration are essential inputs. Adequate support type skills of a high level of competence are of controlling significance.

c. Productivity of timber sale planning and preparation will be lower in the portion of the commercial forest land base within restricted cutting areas such as scenic corridors. Very intensive planning is essential.

d. Cadastral survey support to set or remonument corners controlling National Resource Lands.

e. The plan will necessitate the need for an accelerated survey, design, easement acquisition, and construction of major access roads.

f. An accelerated program of intensive management practices is essential to implementation of the plan. This will also include an increase in the insect and disease control (9700) activity.

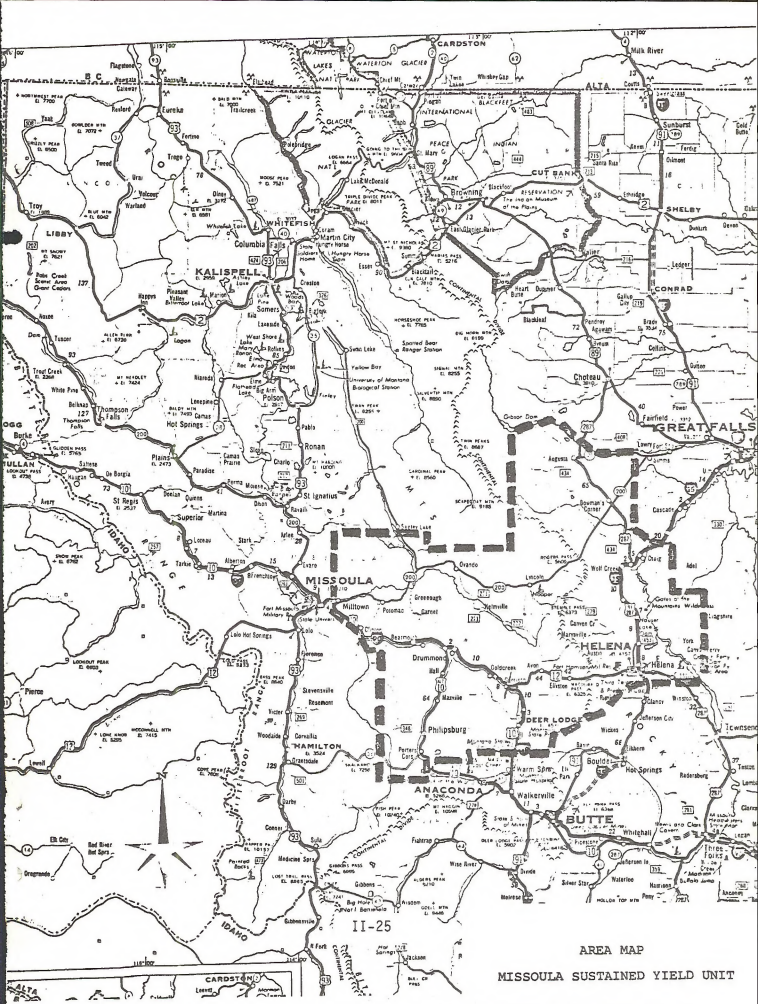
VIII. RECOMMENDATION AND APPROVAL

This plan lists six (6) alternatives for timber production on National Resource Lands in the Missoula SYU. I hereby recommend that Alternative #6, which plans for a sustained harvest of 70 MMBF per decade, be adopted, provided that sufficient manpower and funding is made available on a continuing basis to carry out this plan. If adequate manpower and funding is not available, I recommend maintaining a harvest level within existing manpower and funding limitations, and environmental constraints.

Prepared by _____ _____
Garnet Area Manager Date

Recommended by _____ _____
District Manager, Missoula Date

Approved by _____ _____
State Director, Montana Date


CARDSTON
Malk River
ALTA
WATERTON GLACIER
INTERNATIONAL
PEACE
INDIAN
CUT BANK
SHELBY
CONRAD
KALISPELL
LIBBY
Columbia Falls
Martin City
Essex
Browning
Blackfeet
Chester
Chinook
Havre
Fairfield
GREAT FALLS
Augusta
Choteau
Cascade
Power
Dutton
Conrad
Ledger
Sunburst
Kevin
Sweet Grass
Coutts
Milk River
Whitlash
Dunkirk
Galata
Inverness
Big Sandy
Geraldine
Loma
Fort Benton
Virgelle
Square Butte
Stanford
Judith Gap
Hobson
Utica
Moccasin
Grass Range
Roy
Winifred
Lewistown
Denton
Hilger
Moore
Windham
Ryegate
Harlowton
Shawmut
Judith Basin
Stanford
Hilger
Moore
Lewistown
Denton

RESULTS OF ECONOMIC ANALYSIS

Biological Response Data - Missoula Sustained Yield Unit
Intensive Management Practices - Ave. SI-44 (Range 23 to 78)

All benefit cost ratios and present net worths are given at 5 1/2 percent interest rate.

I. Reforestation

Basic Assumption - All acres which are cut over will be naturally reforested within the appropriate reforestation lags. A backlog of approximately 6,000 acres exists and will be planted within the first decade.

II. Precommercial Thinning - Ages 20

Site Index	Initial Thin Age	B/C	PNW
40	20	.83	-5.12
Break Even Point = Site Index 50			
50	20	1.11	3.92
60	20	1.71	33.96

This program could be used on 15,000 acres in the unit. It is not planned to do any precommercial thinning without subsequent commercial thinning.

III. Precommercial and Commercial Combined - Ages 20, 40, 60, 80

a.

Site Index	Initial Thin Age	B/C	PNW
40	40	.97	-1.38
Break Even Point = Site Index 42			
50	20	1.57	36.39
60	20	2.02	79.95

Ages 30, 40, 50, 60, 70, 80, 90

b. Site Index	Initial Thin Age	B/C	PNW
40	30	.61	-26.69
Break Even Point = Site Index 45			
50	30	1.66	40.59
60	30	1.98	93.60

Ages 20, 50, 80

c. Site Index	Initial Thin Age	B/C	PNW
40	20	.73	-9.77
50	20	.94	-2.18
Break Even Point = Site Index 55			
60	20	1.05	2.07

Because of the difficulty of thinning so many stand so often, thinning program "b." would be seldom used. Program "c." could only be used on the best sites; approximately 15,000 acres in the SYU qualify. Program "a." would be the most common. There are 43,000 acres of site index 45 and above that quality for a precommercial - commercial thinning program.

IV. Commercial Thinning Only - Ages 30, 50, 70

a. Site Index	Initial Thin Age	B/C	PNW
40	20	.90	-4.16
Break Even Point = Site Index 45			
50	20	1.16	6.77
60	20	1.44	19.70

Ages 30, 60, 90

b. Site Index	Initial Thin Age	B/C	PNW
Break Even Point = Site Index 35			
40	30	1.40	18.90
50	30	1.81	47.86
60	30	2.30	107.93

Commercial thinning is the best investment of all practices, particularly probram "b." which can be applied to 80,000 acres of the 100,000 acres in the allowable cut base. The allowable cut assumes commercial thinning on 3,000 to 30,000 acres per decade. This varies over the 400 year period used in the model. Thinnings generally contribute 5 to 10 percent of the allowable cut.

B. Stand Conversion - Not feasible.

EXECUTIVE SUMMARY

LAND USE PLANNING RECOMMENDATIONS

Land use plans for all National Resource Lands on the Missoula District are complete. Those plans provide for coordinated management of minerals, livestock forage, timber, water, wildlife habitat, and recreation.

The more specific land use planning guidelines affecting the Missoula SYU Timber Management Plan are:

a. Timber harvesting activities within near viewing areas (approximately 1/4 mile) of major travel routes such as Highway 200, Highway 10A, and Interstate 90, along the Blackfoot and Clark Fork Rivers, Rock Creek, and near campgrounds or other areas or concentrated public use will be limited to sanitation cutting with emphasis on maintaining aesthetic values and watershed conditions. Areas beyond these near viewing areas extending to ridge tops are called distant viewing areas. Timber harvesting within those areas will be carried out through selective or shelterwood cutting with the prime objective of maintaining aesthetic and visual values.

b. Adequate vegetation will be left along all streams, including intermittent streams, to protect water quality and fisheries habitat.

c. Buffer zones will be maintained a minimum of 150 feet each side of main access roads to protect the watershed, maintain scenic quality,

and provide a screen along these heavily used roads as escape routes for game animals.

d. Conduct the elk-logging study in Chamberlain Creek to determine the effects of different silvicultural systems and associated roads on elk.

e. Essentially unroaded areas such as Wales Creek, Yourname Creek, and portions of the Hoodoo Mountains and Bonner Mountain will remain in their present unroaded status until the results of the elk logging studies are obtained, a multi-resource inventory is completed, and land use plans revised. Part or all of these areas may remain unroaded, depending on other resource values requiring protection.

f. To insure proper development of the timber resource within minimum adverse impacts on other resources, an intensive timber stand andlysis and forest management plan including all resource values will be prepared on a drainage or compartment basis prior to planned timber sales.

g. Water quality information will be otained prior to disturbance near streams flowing through areas proposed for management activities which could adversely affect water quality. Water quality must remain within State and EPA water quality standards.

h. Temporary logging roads will be blocked and seeded at termination of the timber sale.

i. Logging within crucial big game winter range areas may be prohibited or restricted to periods when big game animals are not dependent on these areas.

j. Timber management practices in big game winter range areas shall be done to cause a minimal increase in snow depth and at the same time encourage browse production and increased growth in residual trees.

k. Timber management activities within 100 feet of natural openings, two (2) acres or larger, is limited to removal of high risk trees. All snags adjacent to such openings will be left.

l. Tractor yarding will not be permitted on slopes averaging 40% or more.

m. All timber management activities will be reviewed on the ground by a Wildlife Biologist during the planning stage and again during the implementation stage.

n. Road construction and logging slash should be disposed of so as not to hinder wildlife and livestock movements.

O. Approximately 7,000 acres of commercial forest land in the East Slope, Marysville, and Gates of the Mountains Planning Units (Lewis and Clark County) are classified as protection management areas. Timber harvest will be limited to removal of insect and disease mortality and firewood. Further development of these lands will be considered only after land use plans are revised.

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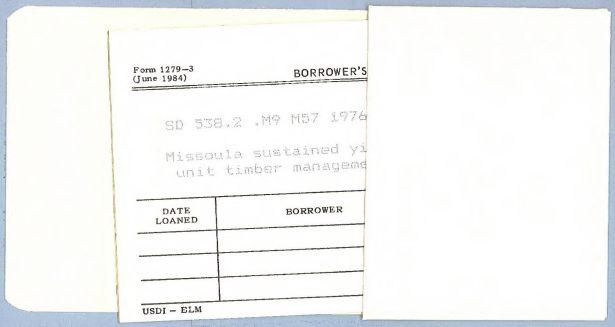

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